WHY CONTENT-ADDRESSABLE RAMs ARE CATCHING ON/82

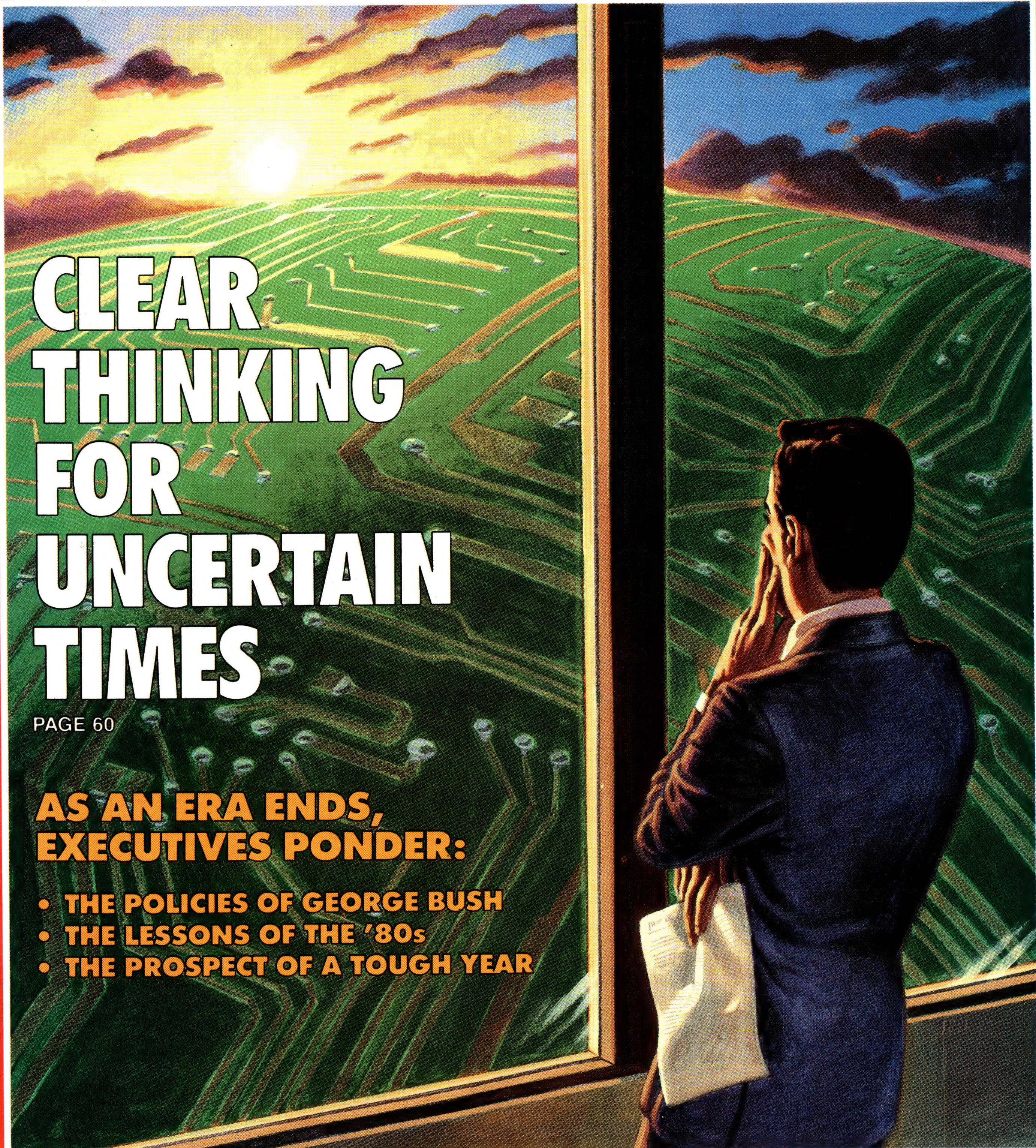
MCC AT FIVE: NOW IT MUST LEARN TO EARN ITS KEEP/89

A VNU BUSINESS PUBLICATION

Electronics®

DECEMBER 1988

-6 JAN



CLEAR THINKING FOR UNCERTAIN TIMES

PAGE 60

AS AN ERA ENDS, EXECUTIVES PONDER:

- THE POLICIES OF GEORGE BUSH
- THE LESSONS OF THE '80s
- THE PROSPECT OF A TOUGH YEAR

are boring.

They're easy to design. They're ready on time. And first-time success is virtually 100%.

You've heard all about the excitement of ASICs.

They improve performance, lower costs and make many new designs possible.

But, unfortunately, you've probably also heard about one big potential problem: while many ASICs pass the tests specified by the designer, they don't always work in the real world. And that causes excitement you can do without.

How to get first-time success.

It starts with our Design Simulation Software. It's been rated the best in the industry by the people who should know—designers who have used it. Within three days, you can be up to speed, working at any of the major workstations in the industry, creating and revising your ASIC with ease.

The standard cell advantage.

You'll really appreciate the power of our standard cells, which allow you to integrate a whole system, including macros, memories, logic and peripherals, onto a single chip.

We have cells with effective gate length as small as 1.5μ (.9μ coming soon). And double-level metal for higher-density chips that can handle higher clock speeds.

You can choose from a wide range of Supercells, including the leading-edge RS20C51 core micro, RAMs, analog functions, bit-slice processors, HC/HCT logic, Advanced CMOS Logic, and high-voltage cells.

If they aren't enough, we can even generate Supercells to your specs.

And we're also in the forefront of silicon compiler technology. So we can offer you the ability to create designs that are heavily BUS-structured, with your ROMs, RAMs, PLAs and ALUs compiled right into the design.

We also bring you the resources of some very powerful partners, thanks to our alternate-source agreements with VLSI on standard cells; WSI on macrocells and EPROMs; and a joint-development agreement with Siemens and Toshiba on the Advancell® library of small-geometry cells.

Gate arrays, too.

If gate arrays are better for your design, you'll be able to choose from our full line up to 50,000 gates, with effective gate length as small as 1.2μ and sub 1 ns gate delays.

These gate arrays use "continuous gate" technology for up to 75% utilization. They are an alternate source to VLSI Technology arrays.

We also alternate source the LSI Logic 5000 series.

And we have a unique capability in high-rel ASICs, including SOS. Our outstanding production facilities here in the U.S. produce high-quality ASICs in high volume at very low costs.

It almost sounds exciting for something so boring, doesn't it?

For more information, call toll-free today 800-443-7364, ext. 25. Or contact your local GE Solid State sales office or distributor.

In Europe, call: Brussels, (02) 246-21-11; Paris, (1) 39-46-57-99; London, (276) 68-59-11; Milano, (2) 82-291; Munich, (089) 63813-0; Stockholm (08) 793-9500.

GE/RCA/INTERSIL
SEMICONDUCTORS

VOLUME 61, NO. 18

COVER: JOEL F. NAPRSTEK

PAGE 60

WORLDWIDE NEWS ANALYSIS

Probing the News

Microprocessors, 29
Can the Europeans create their own microprocessor standard? Nine chip and system houses are giving it a shot

Military, 30
Here's one 'Star Wars' system that's cheap

Supercomputers, 32
It looks as if the Cray-3 will debut in 1989 after all

Fiber Optics, 36C
Philips comes up with a low-cost, easy-to-use fiber

Automotive, 36D
Bosch mounts a campaign to stay the leader in antiskid systems

Components, 36D
How the boss of Siemens' new division aims to make it a success

Telecommunications, 36N
A host of companies move fast to cash in on the UK's microwave antenna boom

Distribution, 37
Kitting gets hot—but make sure you don't get burned

Peripherals, 38
The Japanese launch a major effort in color displays for laptops

Displays, 41
U. S. startups brace for a battle in flat-panel displays

Networking, 43
Low-cost terminals put windowing work-station power on a network

Markets, 46
Buying GE Solid State marks the emergence of a brand-new Harris

COMPANIES

Open Software Foundation, 127
The consortium faces an opposing group backing AT&T as it closes in on a 'neutral' standard

Aura Systems, 129
A startup using an esoteric technology—magnetic suspension—is winning military-systems upgrade contracts

Spider Systems, 130
The Scottish company widens its web, founding a U. S. subsidiary to sell multitasking Ethernet analyzers

PEOPLE

Stephen R. Levine, 132
His Christmas present for Wang—the computer without a keyboard for executives who don't type

Gilbert Cabral, 133
His mission is to take data-switch-maker Micom Communications private to turn it around

DEPARTMENTS

Up Front, 3
Get ready for quick stops and starts with just-in-time inventories

Letter from Kawasaki, 8
Nobody planned it, but electronics development thrives in Kawasaki

Indicators, 120
Equipment: more down than up

Forum, 121
A year after the crash, high-tech venture capital is still flowing

Management Edge, 125
- Pushing quality to the next level
- The National LAN Laboratory tries to keep networks running

Milestones, 139

Readers Report, 142

Book Review, 143
A little insight into Japanese technology—very little

Meetings, 144

Update, 150
Breaking the analog bottleneck

5x the system throughput of the 68030. 2x the 80960 at half the system cost. In CMOS. On the shelf. Now.

Advanced Micro Devices' 29K.
The next platform.

ADVANCED MICRO DEVICES. For more information, write "29K" on your letterhead and mail to:
P.O. Box 4, Westbury-on-Trym, Bristol BS9 3DS, United Kingdom.
Bruxelles (02-2) 771 91 42 • Hannover area (0511) 73 60 85 • Hong Kong (5) 8654525 • London area (04862) 22121
Manchester area (0925) 828008 • Milano (02) 3533241 • München (089) 41 14-0 • Osaka (06) 243-3250 • Paris (1) 49 75 10 10
Seoul (02) 784-7598 • Singapore (65) 225 7544 • Stockholm (08) 733 03 50 • Stuttgart (0711) 62 33 77 • Taiwan (02) 7122066
Tokyo (03) 345-8241 • Latin America, Fort Lauderdale, Florida/U.S.A. Tel: (305) 484-8600 Tlx: (510) 955-4261 amd ftl.
29K logo is a trademark of Advanced Micro Devices. © Advanced Micro Devices, Inc. 1988.

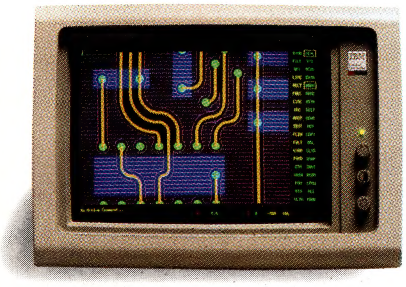
Circle 7

The P-CAD Software That Made This Famous Laptop Computer Is Now Made To Fit Your Budget.

When Zenith Data Systems needed to pack power into their laptop computers they turned to P-CAD®'s Master Designer™ printed circuit board software.

Why? Because only Master Designer was powerful enough to meet their tough requirements.

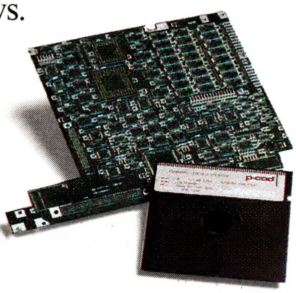
Today, the same software used by Zenith Data Systems and over 10,000 others is available to PCB designers everywhere. Modular software that costs about half what you'd expect.



For starters, Master Designer's schematic capture and interactive layout lets you design using the latest through-hole and surface mount technologies.

Master Designer also features full forward and back annotation. A 6,000 component library manager. Automatic placement and 100% routing. Extensive analog design support. High-speed graphics. And more.

In fact, you'll find it so productive, you're likely to see a return on your investment in 30 days. Or less.



And that'll help you justify even more modules. Such as rip-up and re-try routing. Thermal analysis. Gerber previewing and editing. Analog circuit simulation. A DXF interface for mechanical design and technical publications.

And even though Master Designer costs less, it comes with our full complement of update services and training. Including support from over 50 reseller locations nationwide.

No wonder over 100,000 boards a year are designed with P-CAD software.

For more information call 800-523-5207. In California, dial 800-628-8748. Or send us this coupon and we'll mail you a free preview copy of our PCB Design User's Guide. Complete with a CAD Buyers Guide to help you select the CAD system that's right for you.

And do it now. Because an opportunity like this doesn't fall in your lap every day.

P-CAD is a registered trademark and Master Designer is a trademark of Personal CAD Systems, Inc.

Circle 9

Send me a free preview copy of P-CAD's PCB Design User's Guide.

Name

Title

Company

Address

City

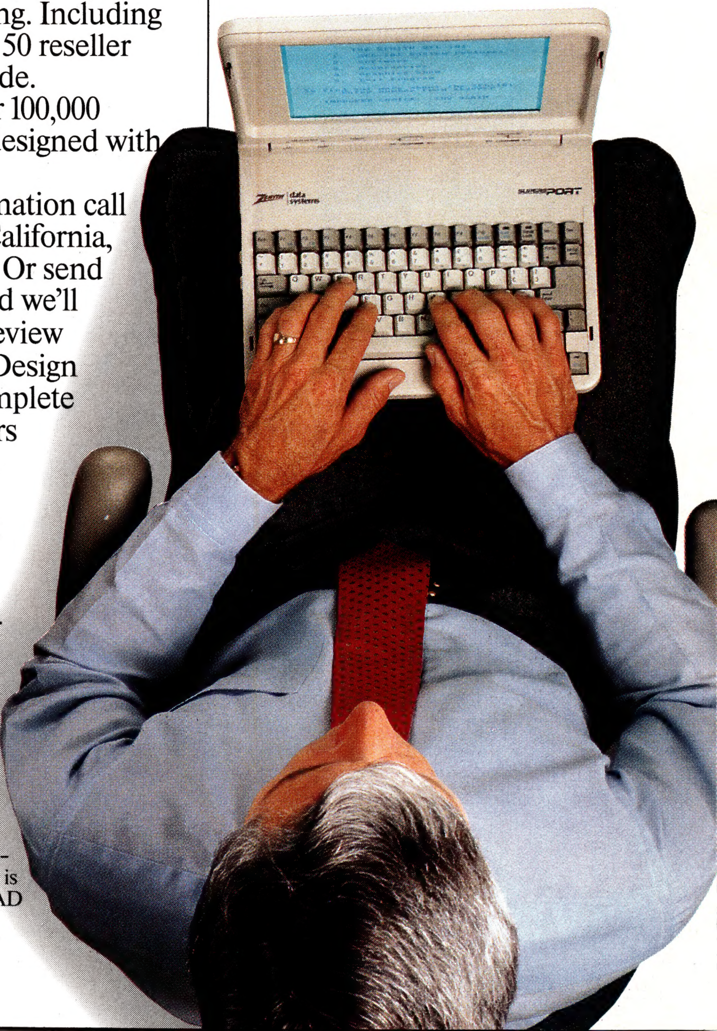
State Zip

EL12/88

p-cad®
PERSONAL CAD SYSTEMS INC.

1290 Parkmoor Avenue
San Jose, California 95126

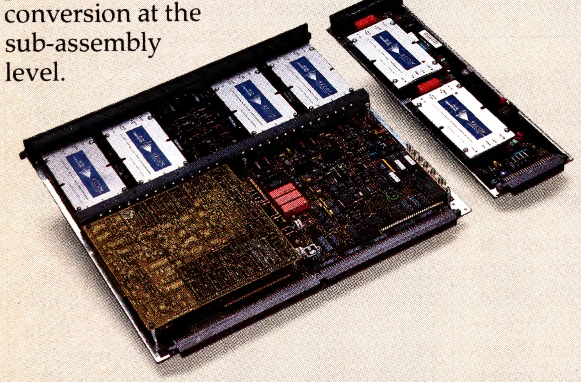
800-523-5207 U.S.A.
In California, 800-628-8748

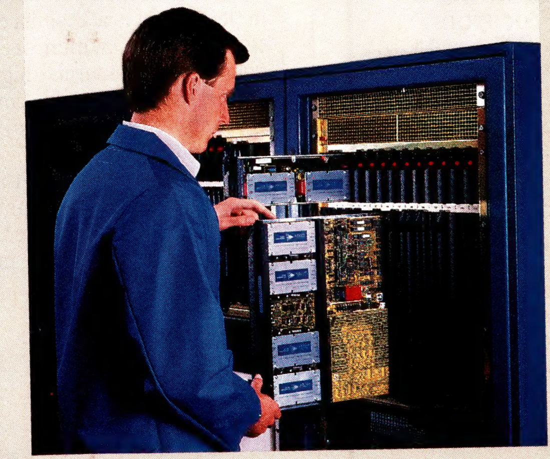


# of power supply solutions

Distributed Power

Advanced system manufacturers are taking advantage of the inherent benefits associated with distributed power systems. Through the use of component level power converter modules, designers are able to effectively decentralize the traditional power system by providing onboard power conversion at the sub-assembly level.





Rear panel of the Hi.T system

The Component

The building block for distributed power is the Vicor VI-200 series of "zero-current-switching", component level, DC/DC converters.

The Benefits:

- Maximum cost effectiveness
- Minimum time to market
- Minimum inventory
- Reduced size
- Efficient power busing
- Modularity
- Flexibility in system configuration
- Enhanced reliability

To discuss your power system requirements, call Vicor today at (508) 470-2900, 23 Frontage Road, Andover, MA 01810.

VICOR CORPORATION

Component Solutions For Your Power System

Circle 11

Great things happen when PCB test data gets passed on to TRACS® 2.0... *faults start disappearing!*

Finding board faults is the major focus in most manufacturing test departments. But the greatest rewards come when you can fix the process that creates the faults. And that's where GenRad's new, second-generation TRACS system comes in.

TRACS 2.0 is a high-level quality management system that collects and analyzes fault data from the board manufacturing and test process and links the faults to their causes. The data is then automatically compiled into management reports that help you fine tune your manufacturing process to help eliminate the causes of faults. TRACS 2.0 even gets you back to your design department to detect and eliminate design problems.

This is the kind of software expertise GenRad has brought to electronics manufacturing/test, since it pioneered the board test ATE industry in 1969. It's the kind of leading edge technology that has kept GenRad the board test market leader for 20 years. TRACS is the ATE industry's leading quality management system with more than 150 customers, including 8 of the top 10 electronics manufacturers in the U.S. and Europe.

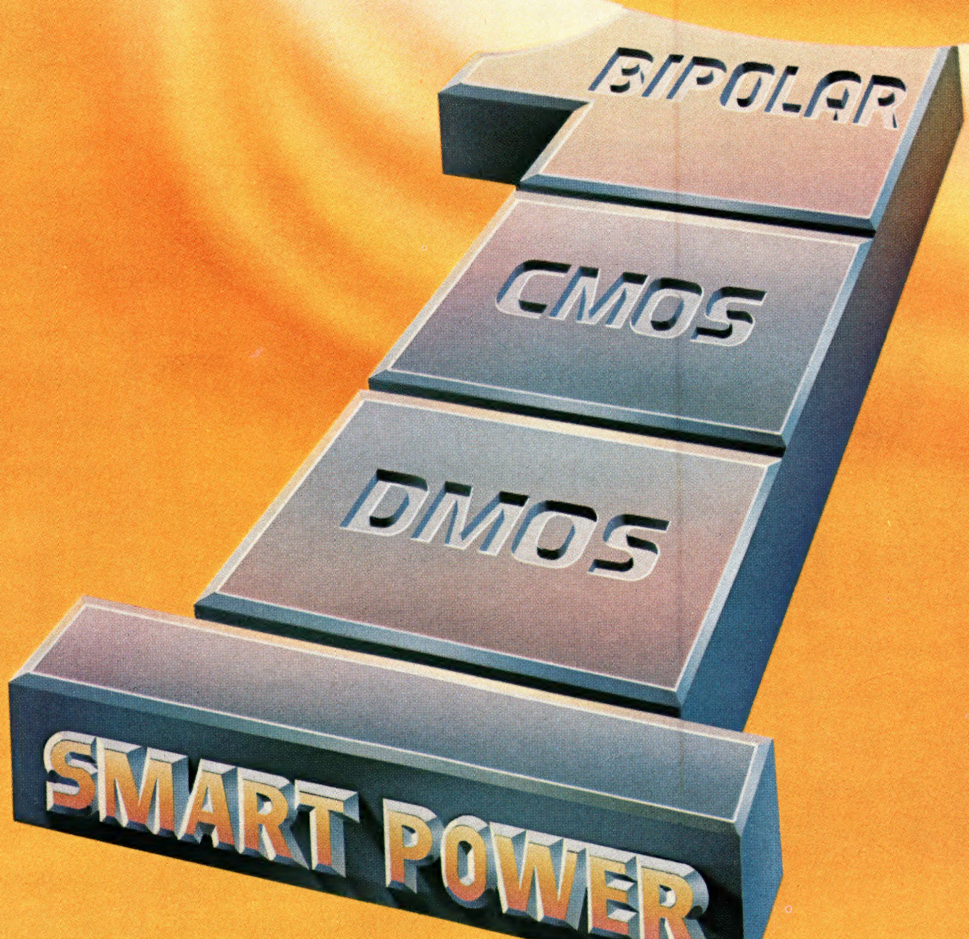
You can experience even greater improvements in your board manufacturing process with TRACS 2.0. For more information, call 1-800-4-GENRAD.

GenRad

The difference in software is the difference in test™

Circle 13

SGS-THOMSON Microelectronics The Brighter Power.



SGS-THOMSON
MICROELECTRONICS

ELECTRONICS NEWSLETTER

NOW, TI AIMS ITS DRAM PATENT GUNS AT MICRON

The international battle over patent rights to dynamic random-access memory technology has taken a sudden domestic turn. Texas Instruments Inc. is zeroing in its legal cannons on Micron Technology Inc. of Boise, Idaho, in an action similar to the nine patent-infringement suits it filed in 1986 against eight DRAM merchants from Japan and one from Korea. Those suits were settled for net royalties of $281 million, and now TI is asking a federal court in Austin, Texas, to stop Micron from making DRAMs and video RAMs that it says violates its patents. Micron officals declined comment immediately after the suit was filed. Analysts estimate Micron made 21.5 million DRAMs in its last fiscal quarter. TI officials in Dallas say they have been trying to reach a licensing agreement with Micron for more than six months. □

AT COMDEX, THE WORD IS THAT 386-BASED MACHINES ARE OFF TO A SLOW START

The talk of the Fall Comdex show was the unexpectedly slow acceptance by personal-computer users of machines based on the 80386 and the newer 80386SX processors. And the chips' maker, Intel Corp. of Santa Clara, Calif., concedes it overestimated demand. Most of those in Las Vegas for the show last month seemed to feel users don't want to buy high-priced 386 machines because their software, written for 16-bit 286-based systems, won't perform that much better on the new PCs. In the meantime, chip makers that second-source Intel Corp.'s 80286 are pushing the clock rate of the microprocessor up to 20 MHz to keep pace with the 80386's performance; that chip is available with 20- and 25-MHz clock speeds. Now, Advanced Micro Devices Inc. of Sunnyvale, Calif., promises a 25-MHz 286. □

PRIME'S NEW PRESIDENT TAKES THE REINS EARLY TO FIGHT A TAKEOVER BID

With a hostile takeover threat looming over Prime Computer Inc., the Natick, Mass., company's new president is hitting the ground sooner and running faster than he expected to. Instead of taking over from outgoing president Joe Henson in January, as planned, Anthony L. Craig moved in as president and chief executive officer Nov. 16. His first order of business will be the takeover bid for Prime by MAI Basic Four Inc., a Tustin, Calif., computer manufacturer. Henson says he stepped aside early to allow Craig, "the man who will lead the company in the future," to handle Prime's takeover tactics. □

QUICKTURN'S ASIC-EMULATION SYSTEM PIQUES THE INTEREST OF CAE AND ASIC HOUSES

Look for joint-marketing agreements to be announced between startup Quickturn Systems Inc. and major vendors of computer-aided-engineering systems during the first quarter of 1989. The Mountain View, Calif., company is also working with application-specific integrated-circuit houses toward deals that may be announced later in the year. What's drawing the interest by the CAE and ASIC companies is Quickturn's Rapid Prototype Machine, introduced last month. The RPM system is a new kind of tool that promises to drastically reduce the number of ASIC chips that don't work the first time they're plugged into the system they're designed for. It uses a large bank of reprogrammable logic chips from Xilinx Inc., San Jose, Calif., to mimic the functioning of an ASIC once its netlist has been generated so real-time, hardware-based debugging can be done at clock rates of up to 10 MHz. ASIC vendors are also interested in adding capability to the RPM so that ASICs with core processors can be thoroughly debugged before committing the designs to silicon. CAE-system makers, for their part, want to integrate the RPM into their ASIC-design packages. □

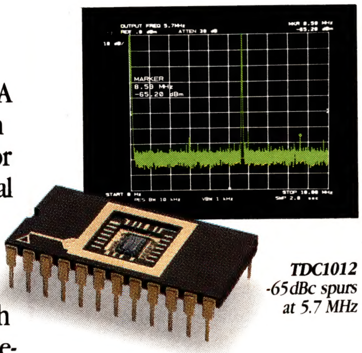
The Glitch is History

The Glitch won't disturb performance or raise the cost of your design again. Not if you specify TRW LSI's high speed 12-bit DAC. Because our TDC1012 is virtually glitch-free. It settles to ±0.012% of full-scale within 30ns. It operates at data rates to a guaranteed minimum of 20MHz, and reduces spurious harmonics to -65dBc or less, all without need of a sample-and-hold.

That's the finest harmonic distortion performance available, yet the TDC1012 is priced about the same as ordinary 12-bit DACs. But because it comes without the Glitch, your system cost will drop dramatically. Why? Because data registers are built-in. You won't need to add them or their potential for ground-loop noise. Nor will you need to de-skew data inputs with individually adjustable trimming capacitors. The peak glitch area is less than 25 pico-volt seconds, an order of magnitude less than other DACs. It will drive a 1V signal directly into a 50-ohm doubly terminated line (40mA full-scale), eliminating the need for an output amplifier. Without the need for trimming, de-glitching and these external components, you'll save time, too.

Segmented architecture that replaces the outmoded R-2R ladder, along with several other proprietary design enhancements help account for the TDC1012's record-setting performance. It belongs in your next digital RF, IF or waveform synthesizer, vector graphic display — or anywhere you need a fast, high resolution, distortion-free DAC. It's available now in ceramic or plastic DIP packages from TRW LSI Products or your nearest Hall-Mark or Hamilton/Avnet location. If you need a faster 12-bit DAC, specify our 50MHz TDC1112.

TRW LSI Products — Bringing the worlds of Data Acquisition and DSP together.



TDC1012
-65dBc spurs
at 5.7 MHz

TRW LSI Products Inc.
P.O. Box 2472, La Jolla, CA 92038
619.457.1000

In Europe, phone:
TRW LSI Products Inc.
Munich, 089.7103.115;
Paris, 1.69.82.92.41;
Guildford (U.K.), 0483.302364

In the Orient, phone:
Hong Kong, Tektron, 3.880629;
Tokyo, Dia Semicon, 3.487.0386,
Teksel, 3.461.5121;
Taipei, Sea Union, 2.751.6856;
Seoul, M.S., 2.553.0901;
Singapore, Seamax, 65.747.6155
Australia, Total, 613.544.8244

TRW LSI Products Inc.

©TRW Inc., 1988 — 712A03088

Circle 19

You can't catch a rabbit who refuses to rest.

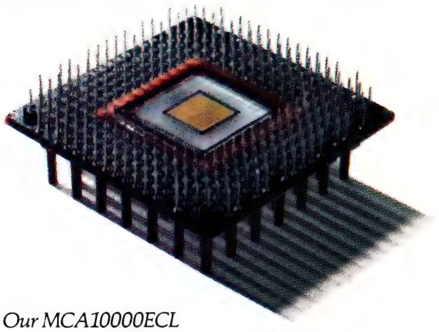
Recently, some ASIC competitors have entered the ECL race and tried to tortoise their way past Motorola's rabbit. Unfortunately for them, they're hoping for a lazy rabbit, while through three generations of ECL arrays the one they're chasing has refused to rest.

So how can they catch an energetic rabbit? They can't.

Performance that won't quit.

Motorola's ECL arrays are the fastest track to total system performance. With speeds of up to 1200 MHz and typical gate delays of 100 picoseconds they're the ultimate in bipolar performance. No longer will designers have to curtail their imaginations to use parts with limited specs.

Motorola ECL arrays not only give you speed and up to 12,402 gates of logic power, they give you the versatility to use them. Programmable speed-power levels put designers in control of both macro and drive currents to allow peak performance where timing is critical and the ability to trim power consumption where speed is less crucial. Three-level series gating lets you multiplex latch inputs without the cost of additional cell usage and delay.



Our MCA10000ECL array is available in a ceramic 235 PGA with 180 I/Os, a polyimide/glass 289 PGA with 256 I/Os, and a 360 lead TAB tape.

Runs faster, cooler and longer.

The MOSAIC III* process used in our third generation ECL arrays utilizes an innovative "edge defined" technique to achieve submicron features without submicron lithography. The end product is very fast—with typical gate delays of 100 picoseconds and metal delays down to 40 ps for a fan out of 2.

An integral heat sink package assures thermal efficiency for reliability and ease of system design. Using impinged air, our packages have a junction-to-ambient thermal resistance of only 2.0°C/W with a forced air velocity of 500 LFPM. This allows high performance arrays to dissipate over 20 watts in an air cooled environment.

Advanced support keeps you race-ready.

To simplify your designs and maximize your potentials, Motorola offers the most comprehensive library available. No longer will you be forced to build system-level functions from a limited selection of library macros and have to accept the loss of performance and density that comes with it. Our library features over 225 functions, three-level series gating, and expandable macros, all of which yield higher performance and better logic density. The library is supported by popular engineering workstations plus a dedicated mainframe which puts even physical layout under your control.

The race doesn't stop.

We know that Motorola has to live up to some pretty tough expectations, after all, we wrote the book on ECL. So we've added a host of innovations designed to make sure your products begin competitive and stay that way. Innovations like tape bonding and STECL outputs.

Multilayer TAB technology provides a controlled impedance environment to minimize interconnect delays. And programmable Series Terminated ECL (STECL) outputs simplify multichip applications.

For more information.

Motorola's ECL arrays provide the most advanced features and the most progressive designs, without ever compromising reliability and the always-important cost/performance ratio.

If you'd like more information about any of Motorola's semi-custom products, contact your local Motorola sales office. For published technical data, just complete and return the coupon below.

We're on your design-in team.

MOTOROLA

*MOSAIC is a trademark of Motorola.

EUROPEAN HEADQUARTERS:
Geneva, Switzerland

SALES OFFICES:
Aylesbury
Copenhagen
East Kilbride (Scotland)
Grenoble
Hanover
Helsinki
Madrid
Milan
Munich
Nuremberg
Oslo
Paris
Rennes
Rome
Toulouse
Sindelfingen
Stockholm
Utrecht
Vienna
Wiesbaden
Zurich

ASIA/PACIFIC HEADQUARTERS:
Hong Kong

SALES OFFICES:
Seoul/Busan
Singapore/Penang
Sydney/Melbourne
Taipei/Kaohsiung
Tokyo

Write To: EUROPE: Motorola Ltd., European Literature Centre, 88 Tanners Drive
Blakelands, Milton Keynes MK14-5BP, United Kingdom
ASIA/PACIFIC: Motorola, International Semiconductor, P.O. Box 80300
Cheung Sha Wan Post Office, Hong Kong

Please send me more information on Motorola's semi-custom ECL arrays.

373ELEX120088

Name ____________________

Title ____________________

Company ____________________

Address ____________________

City ____________________

Country ____________________

PRODUCTS TO WATCH

AMD GETS HELP ON RISC-CHIP DEVELOPMENT TOOLS — FROM HEWLETT-PACKARD

Advanced Micro Devices Inc. hopes to double the rate of design wins for AMD's 29000 reduced-instruction-set processor family by striking a deal with Hewlett-Packard Co. to create a comprehensive set of development tools for the RISC chips. The pact marks HP's first move to offer tools for commercial RISC microprocessors. Its Logic Systems Division in Colorado Springs will develop and market a real-time emulator for the 29000 in its 64700 family, while AMD's Streamlined Processors Division in Austin, Texas, will help develop compatible software that runs on both HP and AMD systems. The tools are due at the end of next year. The agreement also calls for the two companies to support second- and third-generation members of the 29000 line. □

KEITHLEY PUTS ITS TEST SWITCHING MAINFRAME ON AN EXPANSION TRACK

Three new switching cards from Keithley Instruments Inc. pack more versatility into the Cleveland, Ohio, company's Model 707 Automated Switching System mainframe. The Model 7071-4 card targets industrial applications by providing dual 4-by-12 matrix switching. Each of the two matrices offers the four independent signal paths common in industrial tests. The Model 7074 multiplexer card has eight 1-by-12 switching matrices to handle the high-pin-count devices. It is available in either mercury-wetted or dry-reed versions. The Model 7152 card is designed for research applications demanding high-quality measurements. Its 1 pA offset current specification was formerly available only in 1-by-10 matrix configurations. Available now, the 7071-4 costs $2,800; the dry-reed 7074, $3,200; the mercury-wetted 7074, $4,900; and, the 7152, $1,395. □

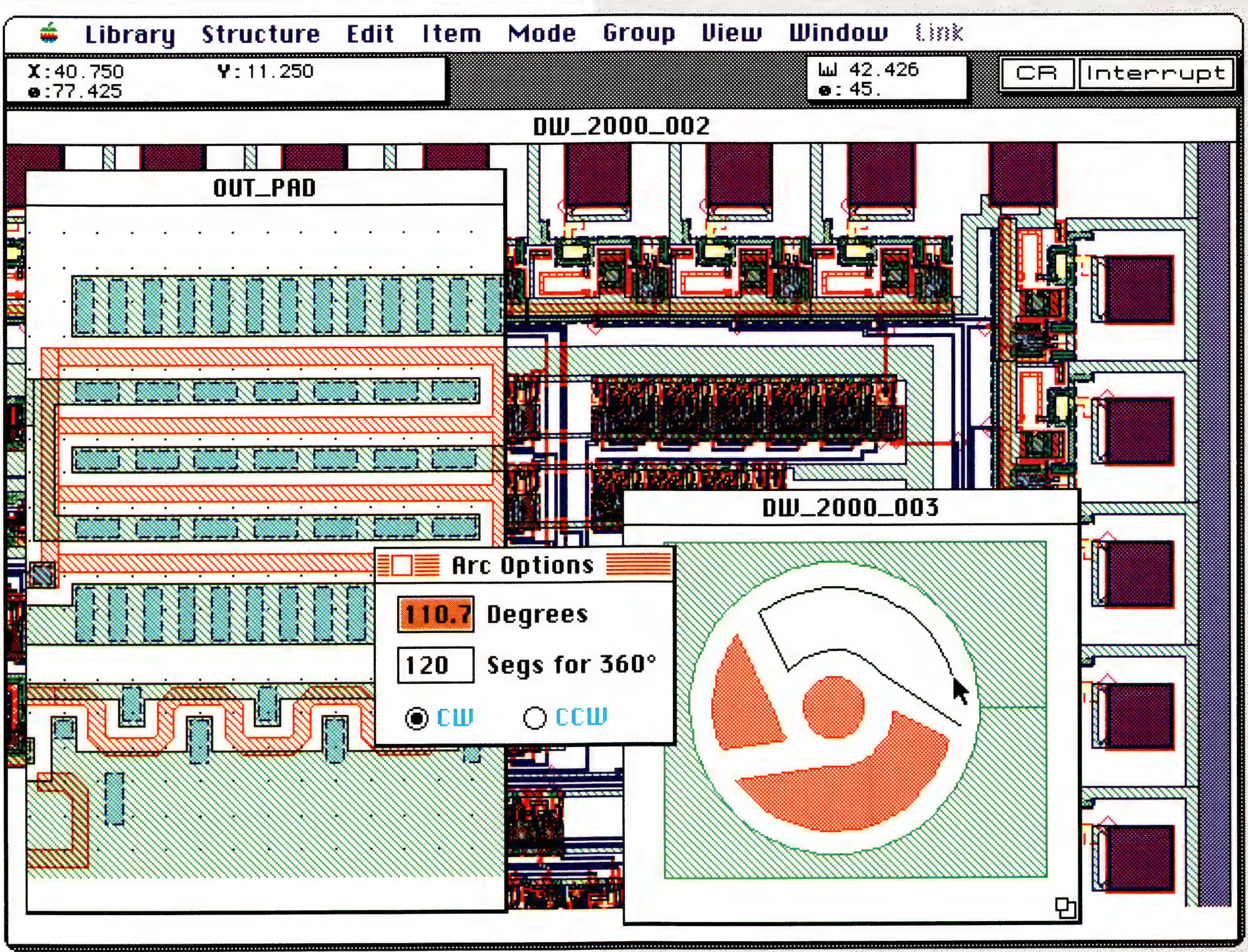
MERCURY TURNS WORK STATIONS INTO PERSONAL SUPERCOMPUTERS

An attached processor board from Mercury Computer Systems Inc. can convert a Sun 3 or Sun 4 work station into a personal supercomputer, the Lowell, Mass., company claims. The MC6400 processor is built around the Weitek WTL 3364, double-precision (64-bit) floating-point chip. The single-slot, two-board subsystem executes vector and scalar operations at a peak of 10 million instructions/s and 20 million floating-point operations/s, with 64-bit double-precision accuracy. Those execution times mean a Sun 4/260 runs almost five times faster. Mercury says the only other 20-megaflops, 64-bit attached processor requires three slots and sells for about $2,000 more than the MC6400. A version of the Mercury subsystem with 4 Mbytes of memory sells for $16,450. Other options include VAST-2, a vectorizing preprocessor for Fortran programs, plus C and Fortran compilers. The MC6400 is available immediately for the Sun 3 and 4; versions are coming next spring for the Apollo 3000/4000, Digital Equipment Corp. MicroVAX, and IBM PC AT. □

IBM BOOSTS TOKEN-RING NETWORK'S SPEED FOURFOLD AND ENHANCES CONNECTIVITY

A series of local-area networking products coming from IBM Corp. will increase the speed of its Token-Ring Network from four million bits/s to 16 million bits/s. The boost in speed comes from several hardware and software improvements, the heart of which are two adapter cards, the 16/4 Adapter and 16/4 Adapter/A. The former allow IBM Personal Computers and IBM Personal System/2 machines to connect with the higher speed networks; the latter allows connections of PS/2s equipped with the Micro Channel architecture. The cards are built around analog/digital chips jointly developed at IBM's Essex Junction, Vermont, and Research Triangle Park, N. C., facilities. Fabricated in 1-μm CMOS, they integrate network functions that previously required six chips. □

the clear choice



X:40.750 Y:11.250
●:77.425

Ш 42.426
●: 45.

110.7 Degrees

120 Segs for 360°

● CW ○ CCW

dw-2000™

- dedicated off-the-shelf workstations
- unlimited die sizes
- multiple windows
- 64 layers/data types/text types
- symbolic capability
- Edit-in-Place
- Add/Sub poly and Fence commands
- arcs and circles
- GDSII and/or Gerber conversion

The throughput solution:

dw-2000™ lets you concentrate on the business at hand - layout and editing. Realize maximum productivity and profit with inexpensive 68020/68030 workstations allowing total freedom and creativity in the design stages of I/C layout. The 4 billion by 4 billion point database supported by dw-2000™ allows for unlimited die sizes using any standard unit of measurement. An extremely flexible and yet simple interface means that your effort goes into designing rather than wrestling with clumsy software. Networking capability with full GDSII compatibility ensures harmonious integration with existing hardware and/or services.

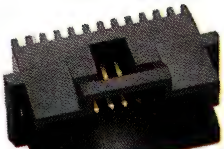
DESIGN
Workshop

Circle 25

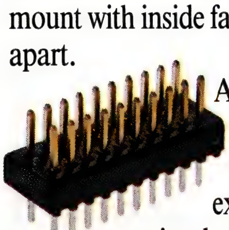
Design Workshop

4226 St. John's Blvd. Suite 400
D.D.O. Quebec Canada H9G 1X5
(514) 696-4753 Fax: (514) 696-5351

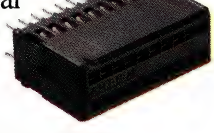
is no small idea.



Example: 2x25 position shrouded headers occupy 1.5″ x 0.284″ of board surface. And parallel boards mount with inside faces a mere 0.450″ apart.

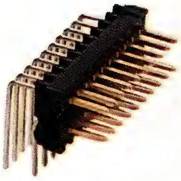


Along with density, you also get the productivity you expect from AMP: simple mass termination, robotic handling features, high-temp housings, selective gold plating. And of course, outstanding quality and reliability.



AMPMODU System 50 connectors are available in selected sizes of 4 through 30 single row positions, 8 through 100 in dual row, with shrouded or unshrouded headers. With all those variations, you could do almost anything your design requires.

Which is our whole idea.



Call the AMP Information Center at 1-800-522-6752 to ask about our AMPMODU System 50 line. For characterized backplane assemblies, contact AMP Packaging Systems Inc., P.O. Box 9044, Austin, Texas 78766, (512) 244-5100, or your AMP Sales Engineer. AMP Incorporated, Harrisburg, PA 17105-3608.

AMP Interconnecting ideas

Circle 27

CAN THE EUROPEANS CREATE A NEW MICROPROCESSOR STANDARD?

Nine eye Europrocessor to counter Intel and Motorola no-license stance

MUNICH

Can nine European system and chip houses pull off an ambitious plan to develop a pan-European microprocessor and declare their independence of U. S. suppliers? Or is the so-called Europrocessor initiative too little and too late?

Some of those in the industry—including Europeans—are skeptical. Others applaud the effort and believe it can succeed. What is certain at the moment is that nine firms will decide by the end of December whether or not to launch a cooperative processor effort which by estimates of insiders will cost several hundred million dollars and be aimed at producing 32-bit designs within three years.

Proponents of the Europrocessor effort expect the group will eventually back more than one processor architecture, but for the time being the discussion is focused on 32-bit reduced-instruction-set computing. A migration path to 64-bit microprocessors is also a key target being considered; so are single-chip microcontroller and 16-bit chip spinoffs from the initial design of the Europrocessor.

The effort to unite European electronics manufacturers behind their own microprocessor standard comes as a complete surprise to leading microprocessor suppliers in the U. S. And, underlining growing European resentment over American-only consortiums launched by the U. S. industry in recent years are desires to keep U. S. firms out of the project in the early stages. For many involved on the Europrocessor committee, U. S. companies now represent a threat in processor products equal to Japan's stranglehold on the market for dynamic random-access memories.

FOR WORLD MARKETS. "The ultimate goal is a microprocessor from European manufacturers for global markets," says Jürgen Knorr, head of the Semiconductor Division of Munich-based Siemens AG. The companies involved are the chip and system divisions of Siemens and Philips; chip makers Alcatel, Plessey, and SGS Thomson Microelectronics; and system houses International Computers Ltd., Groupe Bull, Nixdorf, and Olivetti.

The Europrocessor discussions began over frustration caused by the refusal of Intel Corp. and Motorola Inc. to let other firms second-source their advanced microprocessor chips—Intel's 80386 and Motorola's 68020/68030—say officials backing the effort. The effort is also being fueled by the pan-European fever that is the result of the preparations going on for the united European market scheduled to begin in 1992.

In fact, it is possible that the undertaking might become part of Jessi, the Joint European Submicron Silicon Initiative, which is Europe's attempt to catch up with Japanese and U. S. semiconductor technology by the mid-1990s [*Electronics*, Sept. 1988, p. 56]. That is a union that would please Knorr, who is one of the prime movers behind the Europrocessor. He says it would let the proposed microprocessor combine take advantage of the Jessi developments like computer-aided design and fine-line processing.

Some observers have speculated that

HOW FUJITSU INTENDS TO STAY ON TOP OF SPARC

Fujitsu Microelectronics Inc. has served notice that it intends to be top dog in the Sparc family. Using Wescon as its forum, the San Jose, Calif., company last month said it would come to market in mid-1989 with a 64-bit superset of the Sparc architecture, one that it says will be the first commercial device to attain the theoretical optimum of reduced-instruction-set-computer architecture: one instruction per cycle.

Among the key developments planned is a unique microarchitecture for Sparc processors that contains proprietary pipeline concepts that are optimized for critical load/store and branch instructions. Fujitsu executives believe that the load/store function is the key to accomplishing one-instruction-per-cycle RISC architecture. Fujitsu's next-generation Sparc will also have a dual 64-bit data and instruction bus architecture. In addition, the family will have new fast cache-memory chips and a memory-management unit.

The new Sparc-H series was described to a Sparc vendors' group just two days before the Wescon disclosure because "we just wanted them to know that we had a development that would make their products obsolete," says Tim B. Smith, vice president and general manager of Fujitsu's Advanced Products Division.

This may be the first commercial device to run at one instruction per cycle

Other manufacturers of Sparc-based processors are Bipolar Integrated Technology, Cypress, LSI Logic, and Texas Instruments.

One of the primary benefits of Fujitsu's development is that with absolutely no improvements in process technology or clock rate, performance will be boosted by about two thirds. So where the current 32-bit Fujitsu Sparc implementation, the S-25, provides 15 million instructions per second at a clock speed of 25 MHz (1.66 cycles per instruction), with the one-to-one correspondence between cycle time and instruction execution, a 25 MHz Sparc-H implementation will operate at 25 mips. Existing RISC implementations from other companies, says Smith, with cycle-per-instruction ratings as high as 2.6, would require new processes to achieve clock rates of 30 to 40 MHz for comparable mips ratings.

Although Fujitsu says there is a 64-bit internal data bus, it has not disclosed any other parts of the processor as 64 bits wide. However, the most fundamental design change is a shift from the present architecture to a Harvard-style implementation with separate instruction and data paths. By providing a separate cache/memory management unit for each bus, the bus bandwidth of the processors is increased. This technique can be enhanced by doubling each bus from 32 to 64 bits.

–Bernard C. Cole

The "Look and Feel" CAE Users Have Been Looking For

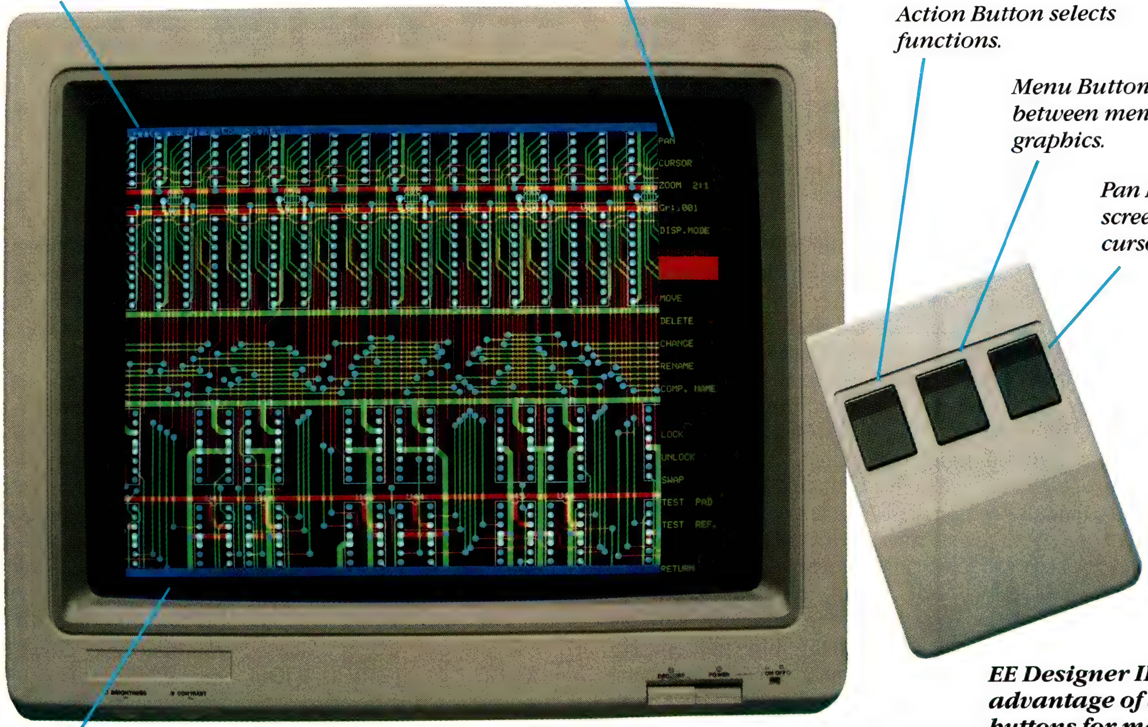
On-Screen Prompt line makes it easy to find the feature you're looking for.

Hierarchical Menus eliminate keyboard commands.

Action Button selects functions.

Menu Button toggles between menu and graphics.

Pan Button Redraws screen around cursor location.



Command Line displays selected function.

EE Designer III supports workstation-quality graphics up to 1280 x 1024 resolution, or uses standard VGA, EGA, or CGA color graphics.

EE Designer III takes advantage of all 3 mouse buttons for maximum operating speed and throughput.

Introducing EE Designer III™

The first ergonomic PC-based CAE software system

The fact is that today's CAE software systems have a lot of features. The problem is that you have to read a huge manual or go to a HELP screen to find the feature you need.

Finally, an integrated desktop CAE software system with all the features you need plus an ergonomic user interface that lets you easily find and access them.

EE Designer III combines on-screen function prompts with a graphic-based hierarchical menu structure.

EE Designer III sets the price-performance standard for CAE software.

- Supports L/I/M EMS Memory for Expanded Database Capabilities
- On-Line Netlist Capture
- Forward and Back-Annotation of Multipage Schematics
- Analog and Digital Circuit Simulation
- Full SMT Support
- 1 mil Grid Resolution
- 45° Memory AutoRouting
- Fabrication/Assembly Drawing Support

So whether you're capturing a schematic or Auto-Routing your printed circuit board you can always find the function you need.

The EE Designer series of products is distributed worldwide by a combination of Visionics Corporation in North America and Betronex Group in Europe, Asia, Australia and South America.

Join the family of over 7000 worldwide users who have found that the EE Designer series of products get the job done.

Outside North America Contact:

BETRONEX
ELEKTRONIK AB
Box 1337
S-181 25 LIDINGO, Sweden
Tel: +46 8 7679205
Fax: +46 8 7318118

In North America Contact:

VISIONICS®
CORPORATION
343 Gibraltar Drive
Sunnyvale, CA 94089
(408) 745-1551 **1-800-553-1177**
Telex: 346352 Fax: (408) 734-9012

Circle 31

SAFT. FOR ALL USERS WHO DEMAND GREAT ENERGY RESERVES.

When performance is of the essence, you must be able to rely on your energy. Your power. Your endurance.

That's why you can always count on SAFT's sealed Nickel-Cadmium storage batteries.

Capacity? From 0.04 to 10 Ah. Power? Guaranteed by our batteries' ultra-thin electrode technology. Life? Often well over 10 years.

As for reliability, it's enough to know that these Ni-Cd batteries are entirely maintenance free — at temperatures as low as –40°C and as high as +65°C.

As a result, SAFT turns up all over the world, used by major OEMs in fields as diverse as electronics, telecommunications, security systems, memory backup, cordless power tools, video, etc.

Whatever your problems with stand-alone energy reserves, SAFT, with its 8 product lines and more than 3000 user references, offers you fully adapted solutions, and even, when required, custom solutions.

SAFT. We put all our energy into ensuring yours.

SAFT
Portable
Battery Division

156, avenue de Metz
93230 Romainville - France
Tél. : 33 (1) 48.43.93.61
Télex : 220 100

SAFT

GERMANY
SAFT AKKUMULATOREN
und BATTERIEN
GmbH
Behringstraße 13
8752 MAINASCHAFF

GREAT BRITAIN
SAFT UK Ltd
Station Road
HAMPTON Middlesex
TW12 2BY

ITALY
SAFT ITALIA S.r.L.
Via Bensi 8
20152 MILANO

SPAIN
SAFT IBERICA S.A.
Artapadura 11
Apartados de Correos 472
01080 VITORIA GASTAZ

SWEDEN
SAFT SCANDINAVIA AB
BOX 2249
103 16 STOCKHOLM

GROUPE
CGE

PORTABLE NICKEL-CADMIUM STORAGE BATTERIES

Circle 304

PHILIPS FIBER HERALDS LOW-COST NETWORKS

EINDHOVEN, THE NETHERLANDS

The dream, as well as the promise, of fiber optics is the eventual replacement of copper in communications systems. But before that can happen, two elements must be in place. First, efficient and economical light sources—lasers or photodiodes—must be developed. And at the same time, the glass fiber itself must be developed to the point where it can carry enough transmission efficiently to make fiber-optic systems economically feasible and easy to fabricate.

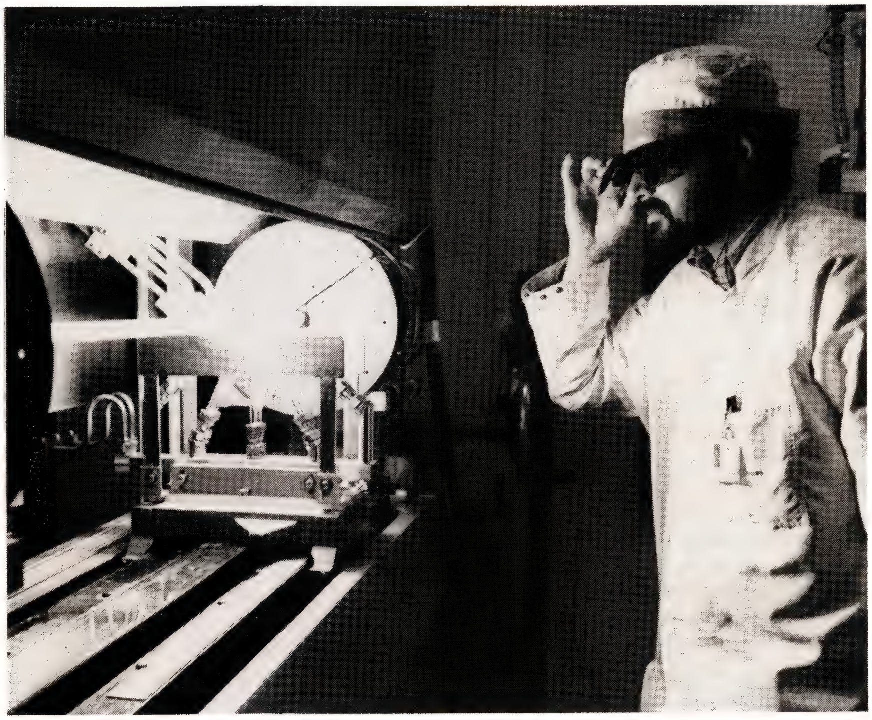
Now, the giant Philips NV has come up with a new type of glass fiber that goes a long way toward fulfilling the need for a low-cost, easy-to-use transmission material. It boasts twice the data-transmission capacity of existing fibers and makes it possible to build economical fiber-optic networks using low-cost light sources. Suitable for long-distance communications, the fiber just went into regular production at the Dutch company's glass-fiber factory at Eindhoven in the Netherlands. It is called dispersion-flattened single mode (DFSM).

In the new fiber, the pulse dispersion—that is, the distortion of digital light pulses during their passage through the fiber—is small over a wider range of the light spectrum than is the case with single-mode fibers that are already in use. These existing fibers have a limited useful range because their dispersion range is only from 1,285 to 1,330 nm. By contrast, the DFSM fiber can be used for wavelengths from 1,285 up to 1,600 nm.

A chief feature of the new fiber is its data-transmission capacity, which is double that of existing fibers. Virtually all fibers now use laser diodes transmitting pulses at 1,300 or 1,550 nm. But the Philips fiber, which uses low-cost photodiodes with much poorer wavelength definition, can accommodate both types of pulses at the same time. Although today's telephone networks do not need the added capacity the DFSM fiber offers, they might some day—and the capacity can be doubled at any time during the fiber's life should the need arise.

A CHEAPER WAY. Besides the efficiency bonus, DFSM fiber offers an economic edge thanks to the photodiodes, which are vastly less expensive than are lasers. This financial advantage brings the complete replacement of copper cables by optical fibers another step closer to reality. And it can result in lower-priced service for the end user.

Last year's trial production of the complexly structured DFSM fiber "proved so successful that we decided to begin regular production this fall," says M. P. Smid, director of optical-fiber activities at Philips. Samples have been sent to communication authorities and cable makers for evaluation and for studying cabling and system implementation.


New optical fibers with double the data-transmission capacity of current types are going into production at Philips' glass-fiber factory in the Netherlands.

Smid adds that his company has proposed the new Philips fiber as a standard to the International Telegraph and Telephone Consultative Committee and to the International Electrotechnical Commission. Philips will incorporate the new fiber into its product range in addition to the existing single-mode and graded-index types.

The DFSM fiber is the result of work dating back to the early 1970s, when Philips researchers began studying the properties and technology of optical fibers. The work they did led to the development of the company's plasma chemical-vapor deposition (PCVD) process for the manufacture of the preform, which results in higher-quality fibers.

With the new deposition process it is possible, by depositing thousands of thin glass layers, to determine precisely the fiber core's composition in order to produce a fiber that has predictable optical characteristics. This means the process is independent of the type of fiber, such as the single-mode or graded-index fiber, that is to be produced.

The deposition process's high fabrication accuracy is responsible for the new fiber's excellent characteristics, Smid says. By using an appropriate number of layer depositions, it is possible to control the profile of the fiber in the core. That permits the core to be optimized for the best parameters, in effect giving the user twice as much for his money. "In a way, the fiber constitutes two waveguides in one," Smid declares. "One waveguide is optimized for 1,300 nm and the other for 1,550 nm.

NEW GENERATION. Philips considers its new fiber a third-generation type. The first-generation fiber, the graded-index version, has a fairly large bandwidth (an average of 2.5 GHz-kilometer), which is sufficient for the vast majority of data-transmission systems and video links.

However, in long-distance transmissions, the graded-index fiber has given way to the single-mode fiber, which is the second-generation type. This variety combines low dispersion, about 2.5 ps/nm-kilometer, with low attenuation, which is important for long-distance telephone transmission lines that have a high information density.

Incremental improvement has played a large role in the development of the new fiber. Since the start of commercial fiber production in 1977, the company has continuously improved the PCVD manufacturing process. That has resulted in the low-dispersion DFSM fiber, and the promise of implementing networks at lower cost.

–John Gosch

FLUKE AND PHILIPS – THE GLOBAL ALLIANCE IN TEST & MEASUREMENT

FLUKE®

PHILIPS

When speed counts...

PM 6654C fast 500 MHz counter

When it's speed that counts, the Philips PM 6654C is the first to finish. With a 500 MHz clock, this sprinter puts 9 frequency digits on display in just one second.

On time measurements, single-shot resolution is an excellent 2 ns. If that's not enough, resolution is an incredible 1 ps on averaged repetitive time intervals. And this performance is reached fast: high-speed averaging gets down to 100 ps resolution on a 1 ms measuring time.

GPIB performance is just as impressive. PM 6654C can transmit up to 420 measurements/s – and 100% bus programmability allows instrument performance to be utilized to the full in automated measuring system environments.

Complementing PM 6654C's unbeatable speed is its great versatility: 14 measuring functions and a bandwidth of DC ... 120 MHz/1.5 GHz cover virtually every requirement.

Making PM 6654C the only choice... when speed counts.

For further information, call your local supplier:
Austria (222) 629141, **Belgium** (2) 5256692/94, **Denmark*** (1) 572222, **Finland*** (0) 5257225, **France** (1) 49428080, **Germany** (561) 5010, **Great Britain** (223) 358866, **Ireland** (1) 952501, **Italy*** (39) 3635240/8/9, **Netherlands** (13) 352455, **Norway*** (2) 680200, **Portugal*** (1) 683121, **Spain*** (1) 4042200, **Sweden** (8) 7821800, **Switzerland** (1) 4882211.*
****For Philips products only.***
For countries not listed, write to: Philips I&E, T&M Department, Building HKF, 5600 MD Eindhoven, The Netherlands.

ADVANCED TECHNOLOGY
MADE TO MEASURE

PHILIPS

Fujitsu's plasma displays.

You have to see it to believe it. Just compare Fujitsu's brilliant, high-contrast plasma displays to any other plasma screens around. The advantages are obvious.

Black (0%)

They start with Fujitsu's 20:1 contrast ratio (about twice the contrast of most other brands). It makes our plasma displays about twice as easy to read under any kind of lighting, and at any viewing angle.

Low (33%)

Then we add four very distinct levels of gray scale. For better representation of all kinds of graphics, from business charts to CAD/CAM.

Medium (67%)

Saves space, saves power, lasts longer

The advantages don't end there. Our CRT-compatible 640 x 400 dot FPF8050HR series and 640 x 480 dot FPF8060HR series are also 10% thinner and require about 20% less power than competitive models.

High (100%)

And, like all Fujitsu products, they're built to last. Up to 50,000 hours — nearly 70% longer than the competition.

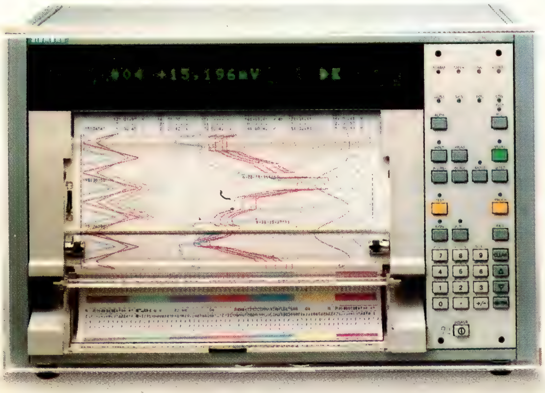
Take a close look at other plasma displays. Then compare Fujitsu's brilliant, flicker-free, high-contrast displays. We think the differences will jump out at you.

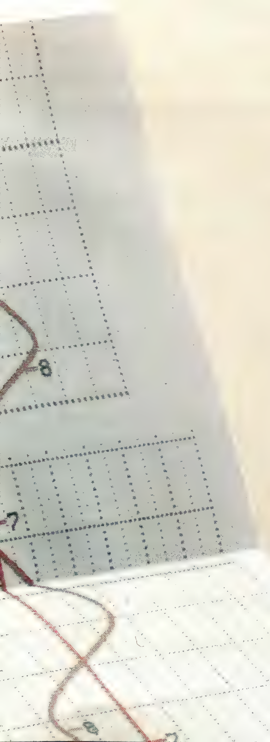
FUJITSU MIKROELEKTRONIK GmbH:
Lyoner Straße 44-48, Arabella Center 9. OG./A, D-6000 Frankfurt Niederrad 71, F.R. Germany Phone: 069-66320 Telex: 0411963 Fax: 069-6632122
FUJITSU COMPONENT OF AMERICA, INC.:
3330 Scott Blvd., Santa Clara, California 95054-3197, U.S.A. Phone: 408-562-1000 Telex: 910-338-0190 Fax: 408-727-0355
FUJITSU MICROELECTRONICS PACIFIC ASIA LIMITED:
805, Tsim Sha Tsui Centre, West Wing, 66 Mody Road, Kowloon, Hong Kong Phone: 3-7320100 Telex: 31959 FUJIS HX Fax: 3-7227984
FUJITSU LIMITED (Electronic Components International Sales Support Div.):
Furukawa Sogo Bldg., 6-1, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100, Japan Phone: National (03) 216-3211 International (Int'l Prefix) 81-3-216-3211
Telex: 2224361 Fax: (03) 216-9771

FUJITSU

Circle 314

...Then move up to the new MULTIREG C1732 hybrid recorder.





Once you needed expensive add-on devices to record periodic quantities captured by your measurement system. Not any longer... because our new MULTIREG® C1732 hybrid recorder registers direct current, D/C voltage, temperature, A/C voltage, and alternating current – all by itself.

With MULTIREG C1732, the move to unique recording convenience begins with your selection of up to 45 separate measurement areas. The system does the rest... by sampling some 32 measurement channels in a mere 1.5 s and plotting the results in 7 different colours. Including full graph annotation for easy interpretation.

But that's not all. MULTIREG also couples functions mathematically... and automatically... and displays the values in graphic form. Giving you a new perspective on complex relationships.

All this with just one hybrid recorder. Hard to believe, but it's true.
And our new MULTIREG C1732 is even available as an individual unit (PIEZOGRAPH 2).

MULTIREG C1732.
Measurement convenience that measures up.

Write to:

Siemens AG
Infoservice 213-Z224 eE
P.O. Box 23 48
D-8510 Fürth

for full details.

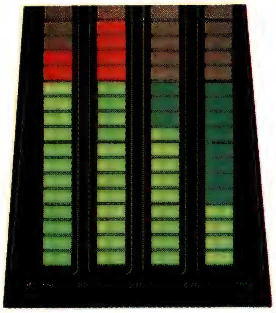
or contact your local Siemens office

Circle 300

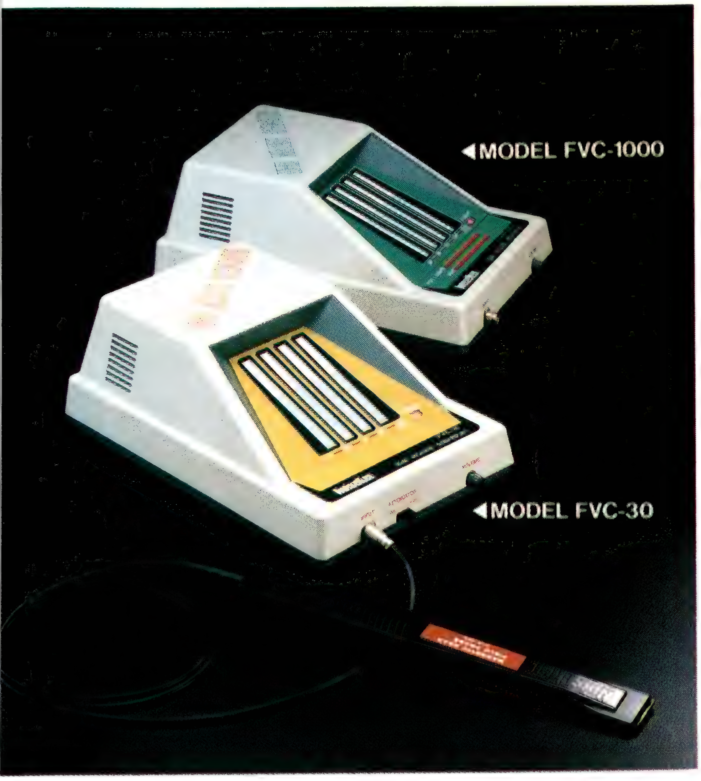
A19100-E688-Z11-V1-7600

NoiseKen

FCC
VDE
VCCI
CISPR



Three points on the display is a criterion for your success in the protective measures to reduce emissions.
Our wide experience in EMI solutions has proven that even products with long wiring or flat cable of high efficiency of radiation are almost sure to clear FCC Class B limits for radiated emissions, if the reading on the FVC-1000 display is not higher than three points.



The FVC series locates sources of EMI

EMI Noise Sensor

Model FVC-1000 Model FVC-30

Features

1. The FVC-1000 can detect and locate sources of radiated interference in electronic equipment.
   The FVC-30 can detect and locate sources of conducted interference in electronic equipment.
2. The user can readily evaluate the effectiveness of protective measures to reduce emissions.
3. For each classified frequency band based on the FCC, VDE, VCCI and CISPR standards, the FVC series measures electric field strength and magnetic field strength individually, which are potential sources of EMI.
4. An electric near field probe and a magnetic near field probe of high sensitivity are furnished as standard accessories.

Equipment summary

	FVC-1000	FVC-30
Frequency range	30MHz～ 88MHz 88MHz～ 216MHz 216MHz～ 470MHz 470MHz～1000MHz ※Simultaneous 4 spectra measurement	100KHz～500KHz 500KHz～ 3MHz 3MHz～ 10MHz 10MHz～ 30MHz ※Simultaneous 4 spectra measurement
Display	20-point LED bar graph display for each frequency band.	20-point LED bar graph display for each frequency band.

NOISE LABORATORY CO.,LTD.
2662-1, NOBORITO, TAMA-KU, KAWASAKI CITY, KANAGAWA PREF, 214 JAPAN
TEL(044)933-4311 FAX(044)932-4511

Circle 308

NOISE®
NOISE LABORATORY CO., LTD.

Talk to Philips and put yourself in touch with the most comprehensive service for custom-made hybrid ICs. An outstanding combination of advanced technology, innovation, expertise and more than 25 years of experience.

In touch with a choice of technologies

As one of the world's largest electronic component manufacturers we can draw on an extensive range of resources to meet your needs precisely and economically. These include the latest production facilities to manufacture hybrids in both thick or thin film.

Thick film is the cost-effective solution for rugged, dependable circuits required to operate over wide temperature ranges. *Thin film* is the technology for higher performance, higher component density hybrids. We can produce fine line resistor patterns down to 25 μm and laser drilled through metallised substrate holes with diameters of only 0.3 mm, to allow very high circuit densities.

In touch with tomorrow

Choosing Philips means you also benefit from our large investments in research and development. For example, our new multi-layer thin film process is facilitating even denser component placement and is ideal for the interconnection of VLSI naked chips.

In touch with total commitment

Look no further than Philips for dedicated support and objective advice through every stage of your project. You will find it easy to get in touch with us; we have hybrid specialists in most European countries. For immediate service call one of our centres listed on this advertisement, or complete and post the coupon, today.

Philips International BV, MC Department (Building BA),
P.O. Box 218, 5600 MD Eindhoven, The Netherlands.

Please send me full details of Philips Custom Hybrid ICs.
My area of interest is:

- ☐ Wired communication
- ☐ Wireless communication
- ☐ Industrial automation
- ☐ Consumer applications
- ☐ Automotive
- ☐ Medical
- ☐ Data processing
- ☐ Aerospace
- ☐ Other(s) please specify

Name

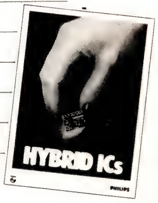
Position

Company

Address

Tel.

EL12/88



For custom hybrid ICs
The name is Philips

PHILIPS

Circle 302

Let JAI compose your own special CCD camera

New 717 CCD Series
- 0.08 lux sensitivity
- Built-in aperture corrector
- White light limiter

JAI gives you the choice between almost 100 versions of CCD cameras for process or security surveillance. You can choose between colour, b/w, gated and high resolution CCD's.

Features:
- weatherproof, separate sensor and basic versions
- front glass heater (in weatherproof version)
- galvanic isolation
- prepared for C and CS mount lenses
- ruggedised
- auto black level
- double AGC
- gamma correction
- pixel clock pulse
- electronic test picture
- auto-iris control

Options:
- motor controlled iris
- external h/v drive
- fibre optical output module
- mains lock
- genlock
- aperture corrector
- single coax supply

You will not have to commit yourself to more than 120 cameras a year to get your own name, logo and colour on them. - Choose JAI. For ultimate flexibility.
Contact one of our offices for further information.

Represented in 26 countries.

jai
jørgen andersen ingeniørfirma as

United Kingdom:
JAI Electro-Optical (UK) Ltd.
1, Tavistock Industrial Estate
Ruscombe, Twyford - Berkshire RG10 9NJ, UK
Phone (0734) 34 29 11
Telex 848906 jai g - Telefax (0734) 34 56 94

Denmark: (Headoffice):
JAI, Jørgen Andersen Ingeniørfirma A/S
1–3, Produktionsvej - DK-2600 Glostrup
Copenhagen, Denmark
Phone 45 2 91 88 88
Telex 35378 jai dk - Telefax 45 2 91 32 52

West Germany:
JAI, Jørgen Andersen Ingeniørfirma A/S
8, Hölderlinstrasse - 6500 Mainz 1
West Germany
Phone (06131) 530 91/92
Telex 4187245 jai d - Telefax (06131) 57 22 63

Circle 312

KITTING SAVES MONEY, BUT HANDLE WITH CARE

LOS ANGELES

Distributors are not kidding about kitting. From an idea rumbling around in the minds of officials at a few companies two years ago, kitting has become the hottest thing in distribution, accounting for up to 20% of sales while serving up 20% to 40% savings in production costs for the distributor's customers.

True to its name, kitting involves delivering a kit or package of selected components to the customer at a specific time—and in a form that can be assimilated into the manufacturing process with a minimum of effort. A complement to the just-in-time manufacturing philosophy, kitting in its most advanced form lets the distributor replace the front end of the customer's production line.

KITTING SAVES TIME

	HOURS BEFORE KITTING	HOURS AFTER KITTING
PURCHASING/EXPEDITING	66.2	4.3
RECEIVING/INSPECTION	28.1	1.6
STOCKING	9.5	.8
PROGRAMMING PARTS	15.5	0.0
PULLING/STAGING KITS	36.7	14.6
INVENTORY CONTROL	21.3	3.3
SHORTAGE PROCESSING	6.7	0.0
DATA PROCESSING	2.9	.2
ACCOUNTS PAYABLE	19.5	1.5
TOTAL TIME SPENT	206.4	26.3

ACTUAL CUSTOMER SAVINGS FOR 10 BOARD KIT, 130 ITEMS PER BOARD

SOURCE: HONEYWELL, INC., COMMUNICATIONS NETWORK DIVISION

But there are some caveats. Though kitting saves the customer paperwork, inspection, and inventory costs, it involves risks for customer and distributor alike. If the kits don't arrive on time, or if they don't meet quality standards, the production line can go down, leaving the distributor with egg on his face. So the distributors that have taken the plunge have implemented special kitting facilities and invested in inventory-processing and -control software.

The result can be a marriage made in heaven. "Distributors manage inventory warehousing best, and customers handle their own manufacturing best," says Stephen McGill, vice president for national sales at Schweber Electronics Inc., Westbury, N. Y. "Kitting lets us take advantage of our mutual expertise."

FAST GROWTH. Several companies are pushing kitting hard. At Bell Industries Inc.'s Electronic Distribution Group, Sunnyvale, Calif., president Howard Franklin estimates that kitting accounts for 20% of total sales and "is growing fast." Jim Smith, vice president of operations and quality assurance at Wyle Laboratories' Electronics Marketing Group, Irvine, Calif., expects kitting sales to reach that level next year. Schweber, which opened kitting centers in Wilmington, Mass., and Irvine, Calif., in June, will not give percentage figures. But McGill says the company has 50 major customers and the ramp-up is on schedule.

The biggest U. S. distributor, Hamilton-Avnet Inc., Culver City, Calif., estimates it will take several years to hit the 20% figure, mostly because it has a billion dollars in business to convert. Bell, Hamilton-Avnet, and Wyle have set the pace with kitting, say most distribution sources, with Schweber making the most heroic effort of the remaining distributors to catch up.

Kitting's advantage is in eliminating paperwork, says Hamilton-Avnet chairman Tony Hamilton. "Instead of ordering 50 parts separately, you can order them with one purchase order." Deliveries go directly to customer production lines, bypassing inventory and many inspection and testing steps, since these are taken care of by the distributor.

The rise in kitting closely parallels the advent of just-in-time delivery for production, since its advantages dovetail nicely. Along with cutting paperwork, it helps to streamline the flow of production by organizing the scheduling and delivery of parts, with the close relationship of supplier and user smoothing rough spots, such as shortages of dynamic random-access memories. "It logistically allows a company to provide high-quality, cost-effective production without inventory and inspection," says Smith. And getting one large shipment instead of many small ones is not to be downplayed as a time-saver, he points out.

However, not every manufacturer is a candidate for kitting, says McGill. So Schweber enforces a qualification program that is operated by local branches and reviewed at the kitting centers. "Since we step right in at the beginning of a customer's production line," he says, "we have to understand very clearly their quality-control procedures. They have to be ready to take material in a production-ready form." Companies most likely to be successful with kitting fall into two groups: intermediate to large operations that are fully automated, and new, small companies that have adopted automated procedures from the start. "There seems to be a broad range of small and intermediate customers who don't fall into either of those camps," says McGill.

The premium for kitting services—compared with simply purchasing components in the normal way—runs from 8% up, depending on the extra services Schweber provides. A common kit with little special packaging or quality-control work on Schweber's part will have an 8% to 10% premium, he says. However, these added costs must be measured against savings for the customer.

Wyle was one of the first distributors to get into kitting, starting five years ago. But the business did not take off until the company made some major investments. It established a special kitting facility in Huntington Beach, Calif., and developed software that cost $500,000. Schweber also made a major software commitment. "We built it from the ground up," says McGill. "We didn't glue together little pieces of systems that already existed." Trying to do a kitting program part time, in a corner of a warehouse, cannot work, says Smith; nothing less than a full commitment will succeed.

Although relatively new, kitting already is maturing rapidly. Distributors are doing partial assembly of components for circuit boards, and the parts are arranged in their manufacturing sequence in the kits. This upward-integration trend is well under way, and Bell's Franklin thinks it may force distributors to decide whether or not to go up the manufacturing chain, into the contract assembly business. "Customers are looking for turnkey capability and distributors may have to do the whole job" to keep the business, he says.

FAILED PROMISES. But Smith says he doubts distributors will take this route. His major worry is about competitors who are not up to doing a solid kitting job, but make big promises and get the job anyhow. "A competitor who has a spectacular failure would hurt us all," he says. Franklin shares this concern over what he calls "a garage-shop mentality." Distributors doing kitting in a sound way are "nearer a manufacturing mentality," he says.

For their part, customers are quick to climb on the bandwagon, but contacts have to be at the vice presidential level and above, says Franklin. One reason is that

DISPLAYS

U. S. BRACES FOR A DESPERATE FIGHT IN FLAT PANELS

SAN JOSE, CALIF.

As Japanese makers unveil color flat-panel displays, a pitched battle is brewing for the emerging multibillion-dollar market for flat-panel displays, with giant Japanese corporations lining up against an army of mostly smaller U. S. companies. The U. S. display makers think they've got all of the weapons they need, but they're beginning to feel a little bit outgunned.

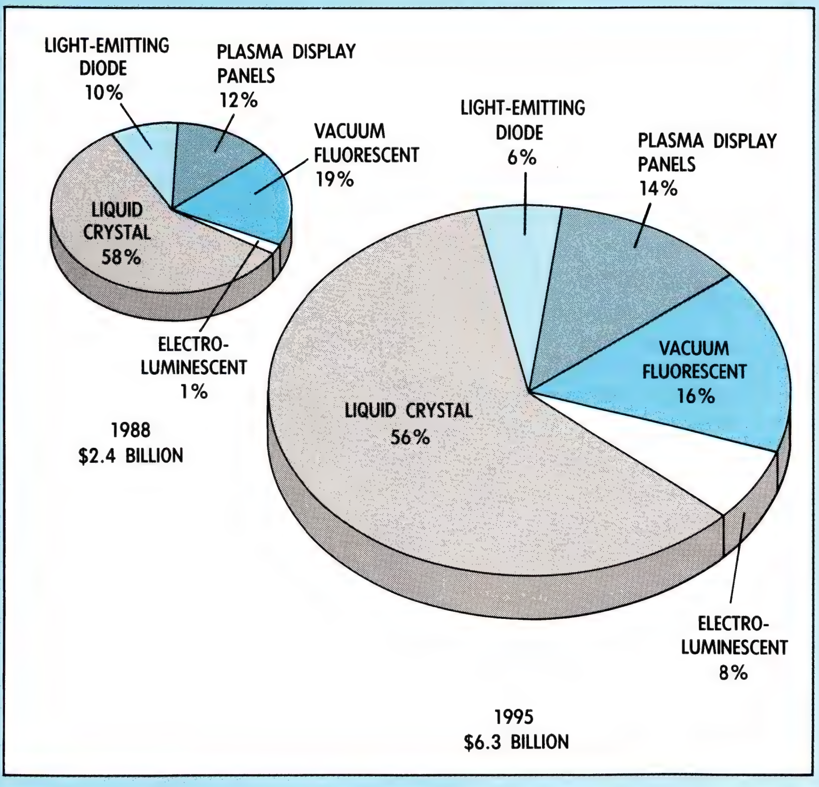
In any case, the days of unreadable, low-resolution displays that can handle only one color are numbered. In the works are flat panels that display either color or multiple levels of gray scale and boast pixel counts that match the 640-by-480-pixel resolution of IBM Corp.'s Video-Graphics Array standard.

Advances in both emissive and passive display technologies are coming at a fast and furious pace. To a large extent, these advances are already being implemented in the coming generation of products, many of which were discussed at a symposium sponsored by Stanford Resources Inc. of San Jose, Calif., and International Planning Information Inc. of Redwood City, Calif.

But also a common topic at the symposium was the face-off between Japanese and American display companies. The Japanese are mounting a massive, well-financed assault on the new market (see p. 38), and the U. S. companies wonder if they can match their development and marketing muscle.

BIG PRIZE. The market they are contending for is considerable, and it's projected to triple by 1995. Flat-panel displays account for a bit more than 25% of today's $8.2 billion market for all types of displays, or around $2.05 billion, says Cindra Trish, a research associate at Stanford Resources. But while the overall market will grow at about a 7.9% compound rate, reaching $14.1 billion in 1995, the flat-panel segment will come close to making up half of it, reaching 43% or about $6.1 billion, she says. Moreover, the market is spread evenly throughout the developed countries—about 25% of the total number of displays produced is used in the U. S., 20% in Europe, 19% in Japan, and 21% elsewhere in Asia. The remainder is scattered about the rest of the world. Trish says the U. S. and Japanese shares will

AT LAST, EL DISPLAYS TAKE OFF



Only One Vendor Delivers All Your SUN Workstation Memory Needs

Clearpoint!

Sun 3/2XX and 4/2XX-Compatible
The SNX2RAM/32 MB, delivering the Sun 3/2XX system maximum on a single board, also offers the enhanced functionality of a microprocessor-managed "on-board hotline" for local and remote diagnostics.

Sun 3/1XX-Compatible
The SNXRAM* fits up to 28 MB in just one slot, freeing four slots for peripherals. Using the latest one megabit DRAMs, you get the highest density plus increased reliability.

Sun 3/60-Compatible
The SNX60 comes in 4 MB SIMM sets that upgrade your Sun 3/60 to an expansive 24 MB maximum. Each SIMM is one MB of memory with a megabit DRAM to support parity checking.

Registered Trademarks—Clearpoint: Clearpoint Research Corp.; Sun: Sun Microsystems, Inc.

Call for our Product Catalog and Designer's Guide to Add-in Memory.

Circle 39

CLEARPOINT

99 South Street
Hopkinton, MA 01748-2204
1-800-CLEARPT (617) 435-2000
Clearpoint Europe b.v. Tel: 31-23-273744
Clearpoint Canada 416-620-7242
Clearpoint Asia 03-221-9726

decline slightly and the rest of the world increase correspondingly, but the overall pattern won't change significantly.

The question is: who will sell the flat-panel displays into those markets? The Japanese display vendors are working hard to make sure they will, says Jim Hurd, president of Planar Systems Inc. of Beaverton, Ore. They have targeted the flat-panel market as one of strategic importance and set up a national project to develop and build the displays. And they generally have a formidable advantage, says Zvi Yaniv, the engineering manager of Ovonic Imaging Systems Inc. in Troy, Mich. Most of them are part of much larger electronics corporations, and as such they share in the engineering and manufacturing expertise of the mother company. That means the Japanese can optimally develop all aspects of the display—the glass, the connectors, the drive chips, the polarizers, and so on.

BAND OF DAVIDS. By contrast, most of the U. S. display companies are relatively small, entrepreneurial operations. Yaniv worries that the Japanese vendors are overwhelming the U. S. competition by their sheer size and the extensive resources their size provides for them. Eventually, he says, they could force the American companies out of the business.

To counter that threat, James Kehoe of Plasmaco Inc. in Kingston, N. Y., calls for increased cooperation between display suppliers and system manufacturers. He suggests there is a need for development relationships, with large system companies helping small display companies offset the high cost of setting up volume manufacturing and their years of research and development.

Where the U. S. companies may have the advantage, at least for the moment, is in the display technology. That advantage can also translate into financial backing. One of the American technology leaders, Planar Systems, builds emissive displays that have impressed the federal government, among others—Planar has won numerous government contracts to create full-color, thin-film, electroluminescent displays. The company has also been partially funded by Tektronix Inc., which gives it some credibility and stability.

The importance of such technological expertise will increase as the nature of the flat-panel-display market changes. Right now, about 44% of all flat-panel displays end up in consumer applications, like digital wristwatches and clocks. The next-largest segment is computer applications, currently about 29% of the market. But by 1995, Stanford Resources projects, computer applications will grow to account for 40% of the market. The growth will come as flat panels advance enough to deliver desktop-like performance in laptop machines and then move into desktop machines themselves, where their smaller size will make them preferable to video monitors.

Tapping the computer market with flat-panel displays will call for technological expertise. To deliver desktop-level performance, a display will have to provide either color or multiple-gray-scale capability, at a resolution compatible with IBM's VGA standard. The precise technology used is less important than the results—various display makers have used liquid-crystal, thin-film electroluminescent, dc or ac plasma, and vacuum fluorescent technology in sizes large enough to deliver resolution at VGA or higher levels. Stanford Resources expects electroluminescent technology to grow the fastest, and it seems to be the technology of choice among the current leaders. At last month's Wescon show, for example, Planar Systems exhibited a monochrome, VGA-resolution, electroluminescent panel. However, Ovonic Imaging Systems is also showing off a 6-by-8-in. panel with VGA resolution. It uses active-matrix liquid-crystal technology that was developed under contract for the U. S. Air Force Human Resources Laboratory. Alphasil Inc. of Fremont, Calif., has an active-matrix LCD panel as well.

These are monochrome displays, but Planar is working on both gray-scale and color versions of its panels. Several Japanese companies are reportedly about to introduce VGA panels with 16 levels of gray scale in the next few months. And one of the first portables to include a VGA liquid-crystal display, the SLT/286 from Compaq Computer Corp. in Houston, already delivers eight levels of gray scale in the VGA mode and up to 16 levels in the lower-resolution computer-graphics-adapter, or CGA, mode.

16 GRAYS. Also delivering gray-scale capability are plasma panels from Panasonic Inc. of Secaucus, N. J., and Cherry Display Products of Waukegan, Ill. Both have demonstrated panels capable of 16 gray levels. Large plasma panels aren't new—in fact, single-level gray-scale panels with diagonals as large as 1 meter that display several million pixels are already in commercial use. But new drive techniques are just starting to let designers achieve 16 levels of gray-scale to mimic the 16 colors available on the color VGA video monitor, says Eric Olson, product manager for Cherry. Vacuum fluorescent panels are lagging in the gray-scale and color race, but at least one company, Futuba Corp. of Mobara, Japan, has demonstrated a 640-by-400-pixel panel with a gray scale.

And within two years, says James Castellano, president of Stanford Resources, full-color liquid-crystal panels and possibly multicolor electroluminescent panels will make their appearance in prototypes of portable computers and in avionic and

Only One Vendor Delivers All Your APOLLO Workstation Memory Needs

Clearpoint!

APOLLO

DN 4000-Compatible

Bring your DN 4000 up to its 32 MB capacity with the **DNX4RAM**. Available in 4 and 8 MB boards, Clearpoint's cost-effective memory provides Apollo-equivalent performance, and adds Clearpoint's unconditional lifetime warranty and 24-hour-a-day product support.

DN 3000-Compatible

The economical 1 or 2 MB **DNXRAM** memory offers Clearpoint's quality engineering and manufacturing with performance identical to Apollo. With an access time of 120 ns, the DNXRAM supports the the DN 3000's 32-bit data bus with byte, longword and unaligned transfers.

Registered Trademarks—*Clearpoint:* Clearpoint Research Corp.; *Apollo:* Apollo Computer.

Call for our Product Catalog and Designer's Guide to Add-in Memory.

Circle 41

CLEARPOINT

99 South Street
Hopkinton, MA 01748-2204
1-800-CLEARPT (617) 435-2000
Clearpoint Europe b.v. Tel: 31-23-273744
Clearpoint Canada 416-620-7242
Clearpoint Asia 03-221-9726

military systems. At Planar Systems, says Jim Hurd, experimental multicolor electroluminescent displays are already functioning in the laboratory. In another year or two, he says, their brightness will have improved to the point that they can be mass-produced.

A color liquid-crystal display with 1,024-by-1,024-pixel resolution has been developed for aircraft instrumentation by General Electric Corp.'s Advanced Displays group in Wilmington, Mass., under a military contract. The panel's image is so much like that of a cathode-ray tube, says Richard Anderson, a senior design engineer for GE, that most people have to look twice to make sure they're seeing a flat-panel display. *–Dave Bursky*

NETWORKING

NOW, LOW-COST TERMINALS CAN RUN LIKE WORK STATIONS

NEW YORK

What behaves like a work station but is priced like a terminal? The answer is a new class of product that still has no generally accepted name but is coming to market fast. Whether the industry decides to it will call them X Windows terminals, X Windows display stations, or network display stations, one thing is certain; they are going to change the way network computing is done.

The first two examples are already here—a low-end model from Acer Counterpoint Inc. of San Jose, Calif., and a high-end unit from Visual Technology Inc. of Lowell, Mass. And at least two more companies are developing their own versions. These products consist of intelligent terminals that support X Windows—the de facto standard interface adopted by the computer industry for graphical displays on networks—and have built-in direct network connections.

"The concept of the network display station offers a new desktop alternative," says Judith L. Estrin, executive vice president of Network Computing Devices Inc. in Mountain View, Calif. "It allows more users to have access to a windowing system for more productivity." Estrin believes these new products will be bought primarily by people who might have purchased ASCII terminals or diskless work stations, and secondarily, by those who might have bought personal computers.

JUST STARTING. But there are no explicit market projections for X terminals, simply because the market is too new. Larry Lunetta, vice president of OEM marketing and sales at Visual Technology, sees the demand "coming from two directions: first is the terminal users wanting communications flexibility and graphical window user interfaces." The second is "from companies now using work stations and PCs and that want a lower-cost desktop device for new users without the operating hassles of a computer."

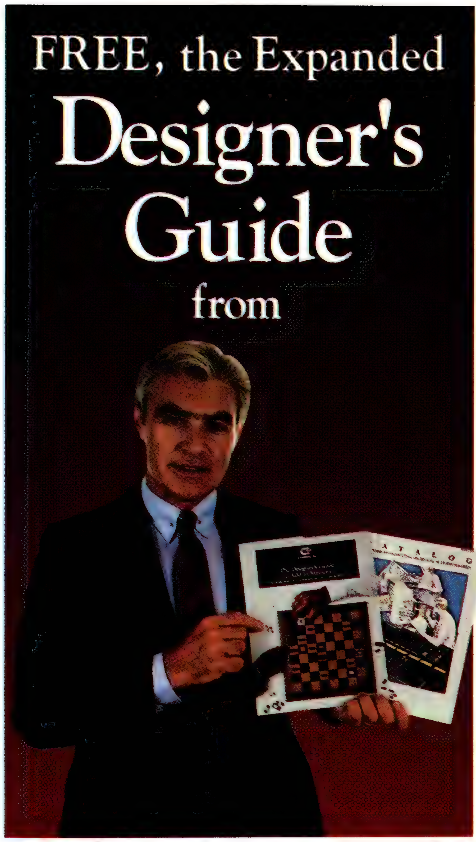
Taking as a starting point the estimate from market watcher International Data Corp. of Framingham, Mass., that 600,000 high-end terminals and 287,000 work stations will be sold in 1989, Lunetta offers a projection. He foresees a minimum of 75,000 X terminals being sold in 1989, with the demand growing to 200,000 in 1990 and 500,000 in 1991. If the average selling price at the low end is $800 to $900 and at the high end, $2,500, and assuming an overall average of $1,500, then the 1989 market for X terminals could be $112.5 million.

No single display option on the market today possesses all the attributes of this new category of product, says Estrin. These include high-resolution window support; communications to any computer on the network; support for any application running on any computer on the network; plus a compact ergonomic design, quiet operation, and affordability.

One of the big advantages of X Windows is that it separates the screen-display management functions from the application interface—these two things can run on different machines. Concurrent applications being displayed on one screen may be running on different computers in the network. These and other features led to quick acceptance for X Windows, which has now been adopted by all major vendors [*Electronics*, Jan. 22, 1987, p. 58]. And because it was developed by the Massachusetts Institute of Technology, the technology is nonproprietary. It's independent of hardware and vendor, operating system, and user interface.

The companies now offering or about to offer X terminals have identified a gap in the display terminal/work station market. This represents a market opportunity for host-dependent display terminals with the performance of 2-d work stations, windows, and prices like ASCII terminals. So the X Windows folks are rushing in with two types of terminals: those that sell for less than $1,000 and offer lower performance—for example, Acer Counterpoint's Xebra Model 100, for original-equipment manufacturers—and those priced at $2,000 to $3,000, such as Visual's 640 X Display Station, that have bigger screens and higher resolutions.

The Xebra Model 100 uses a 10-MHz 8086 microprocessor, 640 Kbytes of random-access memory, and 512 Kbytes of



FREE, the Expanded
Designer's Guide
from
Clearpoint!

Write or call for the 1988 Upgraded Version of the authoritative text on memory. An invaluable reference for buyers with a need to know, the Designer's Guide includes in-depth reviews of buses, systems and management-level concerns of price, performance and reliability. The expanded 1988 edition includes a survey of major systems: IBM – from the 9370 to the PS/2, the HP 9000 line, the Sun 4/2XX and the Apollo DN4000 Series workstations.

Get the New Catalog of Products & Services, too.

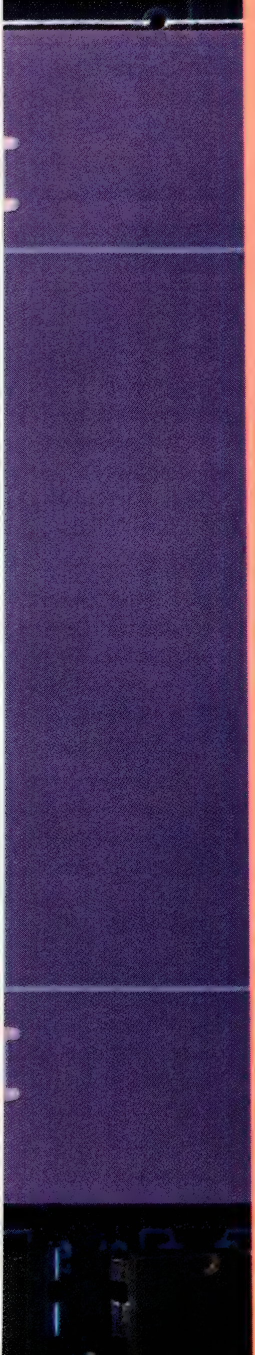
A comprehensive technical brochure, the catalog presents the full spectrum of Clearpoint products, Quality Assurance procedures, customer support and product specifications.

Registered Trademarks—*Clearpoint:* Clearpoint Research Corp. IBM, PS/2: International Business Machine Corp.; *HP9000:* Hewlett-Packard Corp.; *Sun:* Sun Microsystems, Inc.; *Apollo DN4000:* Apollo Computer.

Call Now for Your Free Copies!
1-800-CLEARPT
Circle 43

CLEARPOINT

99 South Street
Hopkinton, MA 01748-2204
1-800-CLEARPT (617) 435-2000
Clearpoint Europe b.v. Tel: 31-23-273744
Clearpoint Canada 416-620-7242
Clearpoint Asia 03-221-9726



Introducing the RISC 7C600 Family: 20 VAX MIPS, SPARC architecture, and development systems today.

Before you design the next generation of highest performance computers, meet the RISC 7C601 microprocessor from Cypress Semiconductor.

You'll build faster systems because this 20 MIPS RISC chip is available today, running at 33 MHz. It outperforms all others using SPARC™ (Scalable Processor ARChitecture), the fastest RISC architecture, implemented in our fastest 0.8 micron CMOS technology for outstanding performance and cool low power.

A complete chip set.

The fastest microprocessor doesn't stand alone. Besides the RISC 7C601 Integer Unit (IU), you can incorporate our CY7C608 Floating Point Controller (FPC) to interface with a standard floating point unit to perform high-speed floating point arithmetic concurrent with the IU.

Although the IU can function on its own with high speed local memory in a dedicated controller application, for most computer applications our high performance CY7C603 Memory Management Unit (MMU) coupled with the IU and FPC gives you the fastest access to both cache and main memory through the 32-bit address bus and 32-bit data/instruction bus. It also supports the SPARC Reference MMU architecture giving you compatibility with standard UNIX® operating systems.

Our CY7C153 32Kx8 Cache RAMs and the CY7C181 Cache TAG RAM maximize your throughput by providing a cache selection capable of running at full speed with a 33 MHz IU.

We also deliver the highest performance SRAM, PROM, Logic, and PLD parts. So you can make the most of those MIPS.

Develop your systems quickly.

You'll build systems faster because the 7C601 is based on SPARC. You have a choice of powerful development systems already running on the target architecture. Plus there's a wide range of UNIX-based languages, tools, and utilities that already run on SPARC. You have more proven development tools, making this RISC easy to integrate into your design.

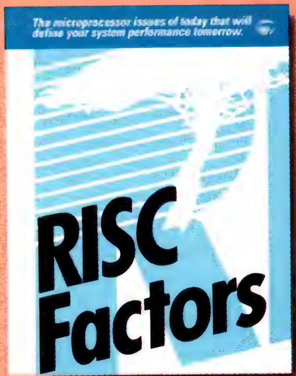
Design around a proven architecture.

The 7C601's SPARC architecture has already been embraced by companies like AT&T, Sun Microsystems, Unisys, and Xerox. And SPARC systems are already on the market, like the Sun-4. In fact, AT&T has selected SPARC for the first UNIX Application Binary Interface (ABI), which will allow all SPARC-based computers to run the same off-the-shelf UNIX applications. With our RISC 7C600 family you're designing around an accepted architecture with unlimited potential.

Make the fastest decision.

Our free brochure, RISC Factors, will give you more information about the factors affecting RISC microprocessors. Because deciding which microprocessor to use is not a snap decision, but it can be a fast one.

Call the RISC Factors Hotline now for your free copy:
1-800-952-6300.
Ask for Department C95.*

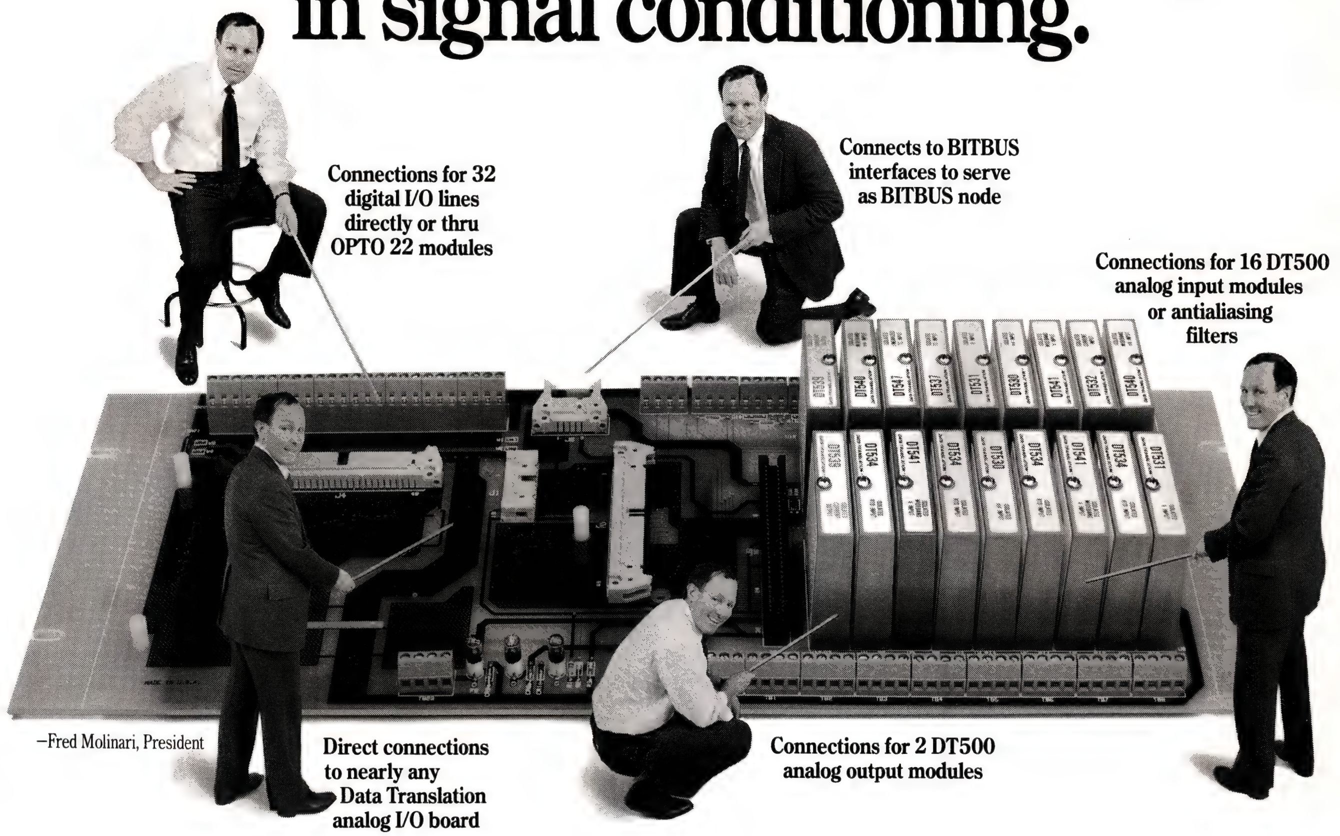

The microprocessor issues of today that will define your system performance tomorrow.
RISC Factors

CYPRESS
SEMICONDUCTOR

---

*1-800-387-7599 In Canada, (32) 2-672-2220 In Europe. Cypress Semiconductor, 3901 North First Street, San Jose, CA 95134, Phone: (408) 943-2666, Telex 821032 CYPRESS SNJUD, TWX 910-997-0753. ©1988 Cypress Semiconductor.
UNIX is a registered trademark of AT&T. SPARC is a trademark of Sun Microsystems.

Introducing some big improvements in signal conditioning.


Connections for 32 digital I/O lines directly or thru OPTO 22 modules
Connects to BITBUS interfaces to serve as BITBUS node
Connections for 16 DT500 analog input modules or antialiasing filters
Direct connections to nearly any Data Translation analog I/O board
Connections for 2 DT500 analog output modules

—Fred Molinari, President

Introducing the new DT760 Isolated Signal Conditioning Panel and DT500 Series Signal Conditioning Modules from Data Translation. They're so complete, we're beside ourselves with excitement.

The DT500 Series includes 55 different isolated modules and 4 antialiasing filter modules for creating any isolation system you need.

And the DT760 panel is compatible with virtually all of Data Translation's data acquisition boards—on the Multibus,™ VMEbus,™ BITBUS,™ STD Bus,™ PC, PS/2,™ Mac II NuBus,™ Q-Bus,™ and more . . . No other system offers you so much flexibility. And it's all on one low-cost panel.

Model Series	Function	Price
DT530	Isolated Millivolt Input	$185
DT531	Isolated Voltage Input	$185
DT532	Isolated Current Input	$185
DT534	Isolated Linearized RTD Input	$185
DT537	Isolated Thermocouple Input	$185
DT539	Isolated Current Output	$185
DT540	Isolated Wide Bandwidth Millivolt Input	$185
DT541	Isolated Wide Bandwidth Voltage Input	$185
DT547	Isolated Linearized Thermocouple Input	$250
DT580	Antialiasing Low-Pass Filter Non-Isolated Input	$185

If you need signal conditioning, everything points to Data Translation. Call us today.

Call (508) 481-3700

In Canada, call (800) 268-0427

FREE

1988 Data Acquisition Handbook Set.

DATA TRANSLATION®

World Headquarters: Data Translation, Inc., 100 Locke Drive, Marlboro, MA 01752-1192 USA, (508) 481-3700 Tlx 951646
United Kingdom Headquarters: Data Translation Ltd., The Mulberry Business Park, Wokingham, Berkshire RG11 2QJ, U.K. (0734) 793838 Tlx 94011914
West Germany Headquarters: Data Translation GmbH, Stuttgarter Strasse 66, 7120 Bietigheim-Bissingen, West Germany 07142-54025
International Sales Offices: Australia (2) 662-4255; Belgium (2) 735-2135; Canada (800) 268-0427; Chile (2) 25-3689; China (408) 727-8222, (1) 868-721; Denmark (2) 274511; Finland (90) 372-144; France (1) 69077802; Greece (1) 951-4944, (31) 527.039, (1) 361-4300; Hong Kong (5) 448963; India (22) 23-1040; Israel (3) 32-4298; Italy (2) 82470.1; Japan (3) 348-8301, (3) 502-5550, (3) 355-1111; Korea (82) 756-9954; Morocco (9) 30-4181; Netherlands (70) 99-6360; New Zealand (9) 504759; Norway (2) 53 12 50; Peru (14) 31-8060; Philippines 818-0103; Portugal 545313; Singapore 7797621; South Africa (12) 8037680/93; Spain (1) 455-8112; Sweden (8) 761-7820; Switzerland (1) 723-1410; Taiwan (2) 918-4740; United Kingdom (0734) 793838; West Germany 07142-54025.

Data Translation is a registered trademark of Data Translation, Inc. Other brands and products are trademarks of their respective holders.

Circle 47

WASHINGTON INSIDER

JAPAN'S PUSH TO LIFT TRADE SANCTIONS GIVEN LITTLE CHANCE

Now that Japan's last-minute effort to get the Reagan administration to lift trade sanctions against Japanese electronics products has been rejected, it isn't being given much of a chance in the next administration. Even Stan Anderson, the Washington attorney for the Electronic Industries Association of Japan, admits that removing the sanctions is "going to be difficult to do politically. The odds don't favor it." The EIAJ is spearheading the campaign against sanctions, along with Japan's Ministry of International Trade and Industry. They say that Japan has fulfilled its obligations, under the 1986 U. S.-Japan semiconductor trade agreement, to open up its domestic markets to U. S. chip makers. The U. S. Semiconductor Industry Association disagrees: it says Japan has made progress, but still has a way to go. The issue hinges on two side letters to the 1986 agreement, which indicate that the U. S. expected the agreement to yield a 20% share of Japan's chip market by 1991, and that Japan accepted that figure as a reasonable expectation. The problem is that U. S. market share has not been growing fast enough to meet that target—it's gaining about 1% each year. Anderson says the EIAJ's position is that "you can't force a sale. U. S. companies have got to perform, and it's very clear that only the top five [U. S. chip makers] have made any significant effort to sell in Japan." Most trade analysts don't think the Japanese effort will work. One, referring to the rejected attempt, says: "The Reagan people would have been doing the Bush administration a disservice by giving up this tool before Bush has a chance to use it. They'd be undermining Bush vis-à-vis U. S.-Japan trade policy." □

IT'S BACK TO THE DRAWING BOARD FOR SUPPORTERS OF THE R&D TAX CREDIT

Technology companies breathed easier in November after a last-minute tax bill extended the research and development tax credit for one more year. But with so short an extension, the elation is temporary. "For long-range planning, these year-by-year extensions don't give us the help we really need," says Ted Heydinger, vice president of the Computer and Business Equipment Manufacturers Association in Washington. The R&D incentive permits corporations to credit their tax bill with 20% of the amount they increased R&D spending over the year. Instituted on a temporary basis in the early 1980s, it's been in jeopardy annually ever since. Hope had run high that the credit might finally be made permanent in 1988, but budget pressures made that impossible. And in fact, the 1989 extension won't be worth quite as much as it was in the past, says James LeMunyon of the Electronics Industry Association. Companies will no longer be able to double-dip—deduct all R&D expenses as a business expense and take a credit for the increase in R&D spending. LeMunyon says the change in effect devalues the credit by 17%.□

MILITARY CHIP MAKERS SLASH DEFECT RATES BY 43% OVER 30-MONTH SPAN

U. S. military chip makers are boosting quality by dropping their defect rate from 190 parts per million to only 107 ppm between January 1986 and June 1988, according to a Semiconductor Industry Association survey of top military chip makers. They included Harris, Intel, Motorola, National Semiconductor, and Texas Instruments, which make up nearly 90% of the military chip market, says SIA's Daryl Hatano, director of international trade and government affairs. Greater concentration on quality, including improved testing and the use of statistical process controls that help maintain consistent performance, brought defects down. Now the SIA plans a similar survey for commercial chips, because though the new figures may vindicate military chip suppliers, their greater value is as a competitive tool: they let member companies see how their quality levels measure up to the competition's. □

Are you missing out on the ASIC Revolution?

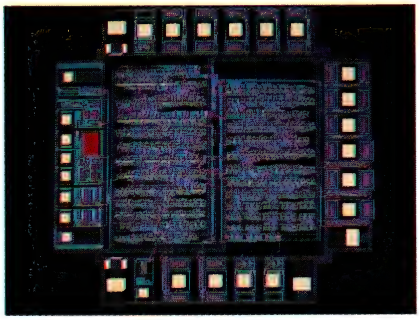
By now, just about everyone knows where the future lies. ASICs offer you: design freedom, improved innovation, less expense, better products, faster path to market. In short, give you the winning competitive edge.

So why have 70% of Europe's electronics companies not used this technology yet?

Firstly, they think the technology's beyond them; and secondly, they think it is expensive.

Times have changed.

This chip was designed in four weeks by an engineer who had never designed an ASIC before!



At ES2 we've become Europe's fastest growing ASIC specialist by completely dispelling all those thoughts.

More than 50% of our designs have come from first-time users.

ES2 will have shipped over 350 different designs by the end of this year.

ES2 will provide prototypes without demanding a production order.

ES2 will provide production quantities as low as 10 pieces – if that's what you need.

Using our ASIC development system, you can sit at your own desk creating and designing as much as you wish.

We can take one of your electronic engineers who has never designed an ASIC before,

We Guarantee you won't!

and have them designing their first ASIC within days ... and loving it – we guarantee it.

So why not find out more about ES2, and what it can mean for your company? Our brochure will reveal all in simple, easily-understandable terms – but then, direct writing is our whole approach to ASICs!

THE ES2 GUARANTEE

We guarantee to everyone attending the ASIC workshop – working silicon or we will return your course fee.
Our success as the fastest growing ASIC vendor gives us this confidence.

EUROPEAN SILICON STRUCTURES

Central Europe
Industriestraße, 17, 8034 Germering, W. Germany
Telephone: (089) 8 49 39 0
Northern Europe
Mount Lane, Bracknell, Berkshire RG12 3DY, UK
Telephone: (0344) 52 52 52
Southern Europe
72-78 Grande Rue, 92310 Sèvres, France
Telephone: (1) 46 26 44 95

I am interested in the ES2 ASIC Workshop opportunity. Please send me details of
ES2's ASIC Workshop ☐ *ES2 Products* ☐

Name: ____________________

Company: ____________________

Address: ____________________

____

Tel: ____________________

Please return this coupon to your nearest Business Centre, marked: "Attention Training Director"

AND SOME THINGS ARE.

$50*
VLSI RISC Chip
12 MHz, 6.33 MIPS

peripheral support we do. Nobody.

Ours is the only RISC chip with off-the-shelf peripheral support for memory, video, audio, and other I/O functions.

Don't want to mess with microcode? That's okay. ANSI C, FORTRAN 77, and an Assembler/Linker will do very nicely, thank you.

And we're working on development support tools like industry standard real-time executives and in-circuit emulators.

But we saved the best for last. Because VLSI is a leader in ASIC and always has been, we're now using our RISC as an ASIC core.

That means you can build your very own RISC system quickly and easily using VLSI design tools.

Call 1-800-872-6753 and ask for our free VL86C010 brochure. Or write to us at 8375 South River Parkway, Tempe, AZ 85284.

And reduce your RISC.

*Prices based on: EDN, June 9, 1988; Electronics, April 14, 1988; Microprocessor Report, May and September 1988; Quantities of 100. **Price based on sample quantities.

Circle 53

VLSI TECHNOLOGY, INC.

PACIFIC RIM TRENDS

JAPAN'S MITI WANTS TO POUR MORE CASH INTO SOFTWARE PRODUCTIVITY

The Japanese may not be able to erase the American lead in software development, but it isn't for lack of trying. Not content to rely on the five-year, $200 million Sigma Project to improve software-development productivity, the Ministry of International Trade and Industry wants a follow-up project, which it has dubbed SuperSigma, targeted at even greater improvement. MITI has requested another $200 million for a five-year sequel to the current project, which will continue through the end of fiscal 1989. Sigma, which stands for software industrialized generator and maintenance aids, aims only at source-code compatibility from system to system. [*Electronics,* June 1988, p. 57]. But SuperSigma is far more ambitious: it would develop an interface that makes different types of computers compatible, as well as both programming languages and a new standardized operating system. ☐

IBM PUTS MORE SOFTWARE MUSCLE INTO THE ASIAN-PACIFIC MIDRANGE MARKET

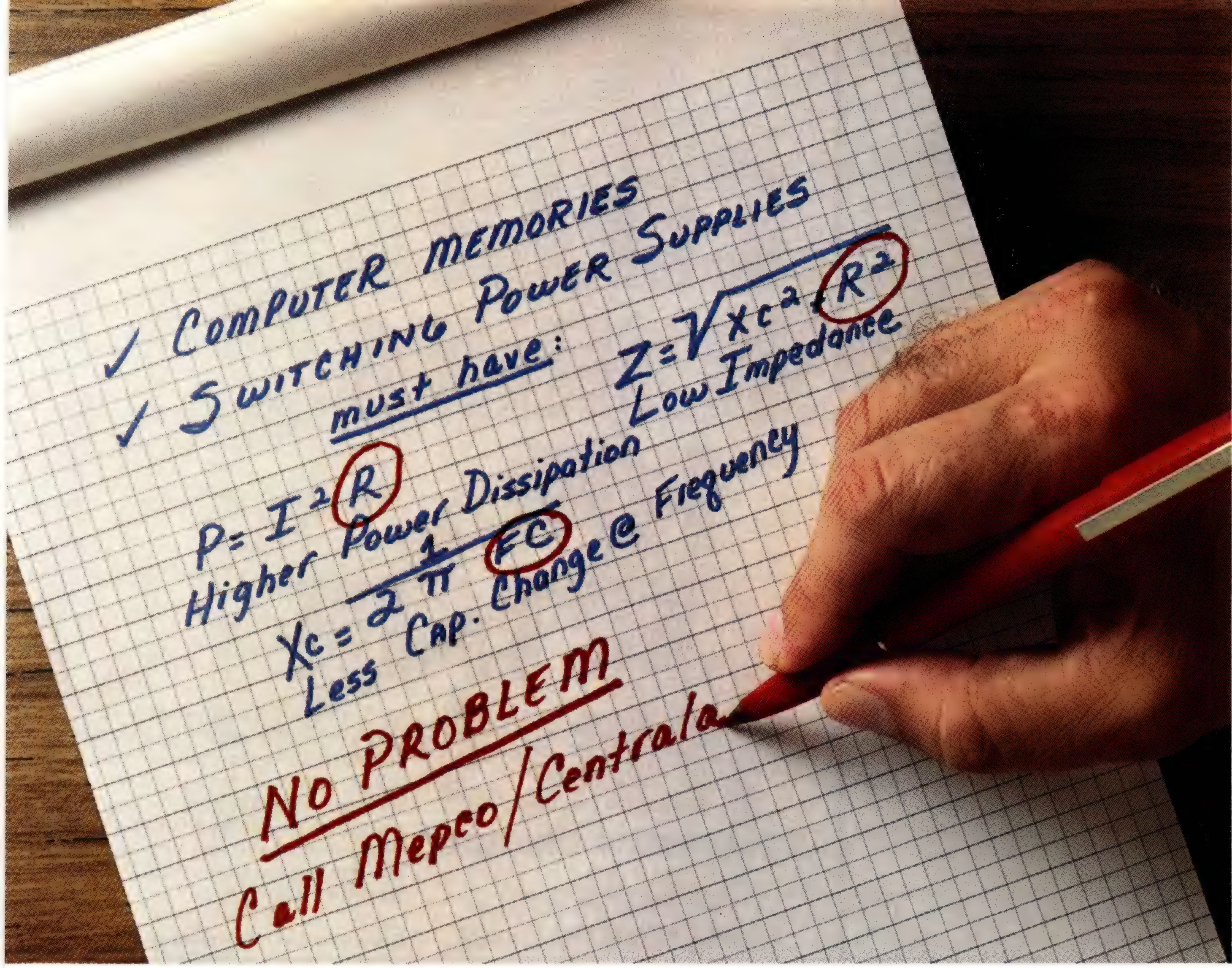
Big Blue is making a big move in its Asian-Pacific markets. IBM Corp., looking to induce both new and existing customers to invest in its midrange AS/400 computers, is increasing the number of software packages available and is also customizing them for individual customers. To accomplish this, four IBM subsidiaries will establish so-called Software Partner Laboratories in Tokyo, Taipei, Singapore, and Seoul. The first one working is the lab in Tokyo, which is equipped with one AS/400-B60 and 36 terminals. It is manned by four systems engineers who will develop new applications packages, and also translate English-language packages into Japanese-language versions. The lab will also be opened to 15 software houses that will cooperate with IBM Japan in developing applications and recompiling for the AS/400 some application packages that are now used for other computers. IBM Japan expects that the 360 application packages, available in June when the A/S400 series was announced in Japan, will be augmented at the rate of about 50 packages a year. And in another move aimed at enticing customers with service as well as product, IBM will establish regional software customization centers throughout Japan. ☐

NEC IS ALREADY PLANNING ITS 16-MBIT DRAM PRODUCTION

Even before it has started commercial production of 4-Mbit dynamic random-access memories, NEC Corp. is gearing up to turn out 16-Mbit parts. The Tokyo-based company plans to start construction this month on a $160 million wafer-fabrication line for prototype production of 16-Mbit DRAMs in its Sagamihara plant. The new fab line, which will be able to process more than 2,000 6-in. wafers a month, is scheduled to start operation next fall. Commercial sample shipments of 4-Mbit DRAMs from NEC and other Japanese semiconductor manufacturers—including Toshiba, Hitachi, and Mitsubishi Electric—will start in December. Those four, plus Oki Electric Industry Co., which says it started commercial sample shipments in October, began shipping engineering samples of 4-Mbit DRAMs last spring and summer. ☐

SEGA ADDS A HO, HO, HO TO SIGNETICS' CHRISTMAS WITH A FIRST-TIME CONTRACT

A Japanese toy maker expects to make Christmas happier for Signetics Corp., the Sunnyvale, Calif., subsidiary of Philips International NV, of the Netherlands. Sega Enterprises Ltd. of Tokyo, a leading Japanese manufacturer of electronic games and toys, has announced that it will buy Signetics' version of the 68000 16-bit microprocessor. This is the first time that a Japanese toy maker has contracted to buy its chips in the U. S. Sega will buy one million pieces during the first year of the multiyear arrangement. ☐



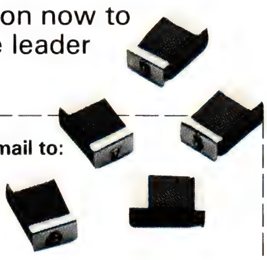
Specify Star Chip® Tantalum Capacitors!

Make a note to give your computer memory and switching power supply designs more efficiency and reliability with highest-performance Mepco/Centralab capacitors.

You want performance: Our unique (patented) 49XC Star Chip® Tantalum Capacitors, in ratings from 1.0 to 220 µF, provide unrivaled electrical/mechanical characteristics — lowest ESR, low impedance, minimal capacitance change and higher power dissipation at 100 kHz to 1 MHz, and higher. Plus survival at cryogenic temperatures!

You want selection: Choose our Star Chip® Tantalum Capacitors with ESR of 50 or 100 milliohms at 100 kHz — in 100 µF at 10 volts, 47 µF at 10 volts, 22 µF at 20 volts, 10 µF at 25 volts, or 33 µF at 15 volts. Higher capacitance, coupled with stability over frequency, provides low impedance.

Jot this down: Send this coupon now to Mepco/Centralab — the active leader in passive components.



Attach coupon to your letterhead and mail to:
Mepco/Centralab
Attn: Corp. Advertising
2001 W. Blue Heron Blvd.
P.O. Box 10330
Riviera Beach, FL 33404

☐ Please send engineering samples and data for________ capacitance/________volts at________frequency.

☐ Please have application engineer call.

Name/Title ________
Firm/Dept./Div.________
Address/MS ________
City/State/Zip________
Phone(   )________Best Time________
ELE 12/00/88

MEPCO/CENTRALAB
A DIVISION OF NORTH AMERICAN PHILIPS CORPORATION

PHILIPS

Circle 59

®Star Chip is a trademark of Mepco/Centralab.

like, and consumers don't either, is uncertainty. And we will see a continuation of the Reagan policies."

John H. Krehbiel Sr., chairman of Molex Inc. in Lisle, Ill., echoes that sentiment: "Bush will provide a continuation of Mr. Reagan's policies, which I think are favorable to business, particularly to the electronics business. I'm sure he will keep a strong defense system."

But Bush won't have the money in his budget that Reagan had. Indeed, while he has promised a strong defense, "the truth of the matter is, the defense budget's going to be down in real terms regardless," says J. Edward Waesche, chairman of the Electronic Industries Association's 10-Year Forecast Committee, and director of strategic and market planning at Grumman Corp. in Bethpage, N. Y. "It's going to keep dropping through 1994."

Another problem for Bush will be his lack of a mandate. Reagan's landslide victories in '80 and '84 gave him the clout to complete his agenda. Without that kind of mandate, Bush will have to work more closely and diplomatically with Congressional leaders to achieve his aims. So while Reagan was able to maintain his hard-line conservatism when he took over the Oval Office, Bush most likely will have to back down a little.

"Irrespective of campaign rhetoric, when the person steps into the office, a moderating effect takes place," says John Kreick, president of Sanders Associates Inc., the Nashua, N. H., defense contractor. And even if that weren't the case, "the defense budget is virtually set for two years and it would be very difficult to make any real changes in 1989."

So like Grumman's Waesche, Kreick says he's "planning on a flat [defense] budget for the next two years, and maybe for the next three or four." And even if the defense budget does hold steady at nearly $300 billion a year, much of that money goes for personnel and facilities—so much, in fact, that "procurement will probably dip slightly."

Of greater concern to many in the electronics industry is the effect George Bush will have on the U. S. industrial base and on U. S. competitiveness abroad. Competitiveness was a key issue in the campaign. Democrat Michael Dukakis promised "good jobs at good wages" and a U. S. trade policy that would force trading partners to fully open their markets or risk losing access to U. S. markets. Bush vowed "to keep America moving forward" and to stand up and fight against protectionist sentiments. Now Bush must face the reality that the U. S. is losing its mastery in many critical technologies—those needed for both a viable defense and a viable economy in the years and decades ahead.

"What happened through the Reagan years is that we've lost [much of] the country's industrial base," says Michael Bolan, vice president of marketing at Dallas Semiconductor Corp. in Texas. An overemphasis on cutting costs helped push many manufacturing industries—and the jobs and technological expertise that go along with them—overseas.

Grumman's Waesche agrees, but he believes Bush recognizes the need to strengthen the industrial base. "The Defense Department has consistently undercut the technology base," he says. "The emphasis has been on the high-priced strategic programs. But I think that's going to turn around now. The tech base has been a very, very small part of the defense investment, but it should grow." Such investments as Sematech, the semiconductor manufacturing consortium to which the DOD is committing $100 million a year through fiscal year 1992, are the keys to a revitalized technology base, he says. And others are likely to follow.

The competitiveness issue is not going to disappear, says Grant Dove, chairman and chief executive officer of the Microelectronics and Computer Technology Corp. in Austin, Texas. "If anything, the Europe 1992 thrust [toward a unified market] is going to bring more into focus that the Europeans are very, very serious about their internal electronics and information-technology competitiveness"—just as serious as the Japanese. And if the U. S. wants to keep up, it may have to fight back with similar investments straight from the national treasury—investments in such technologies as high-definition television, for example.

"We have seen with Sematech the government—under great strain, I guess—agreeing to get into a semiconductor partnership," Dove says. "That's a way of life in Japan and now in Europe." So Bush will be under great pressure to support technology businesses through consortia and tax incentives, such as the research and development tax credit. "I would hope that [the Bush] administration will look seriously at these issues and try to decide how this partnership between government and industry can be best implemented," Dove says.

Next year will see a downturn, most industry executives expect. The issue for them is when it will start and how hard it will hit them.

Given what they see as inevitable, most are fairly optimistic. They don't think a downturn necessarily means a serious slump. And some point out that for a couple of years they've been saying the good times can't last—and then watching the economy pick up steam and the electronics industry notch another few percentage points of growth.

A fairly typical view is that of Frederick C. Sehnert, president and chief executive officer of Wavetek Corp. in San Diego. "I don't see a recession for the first six months of '89, but it's hard to believe that the economy can go another year without one," he says.

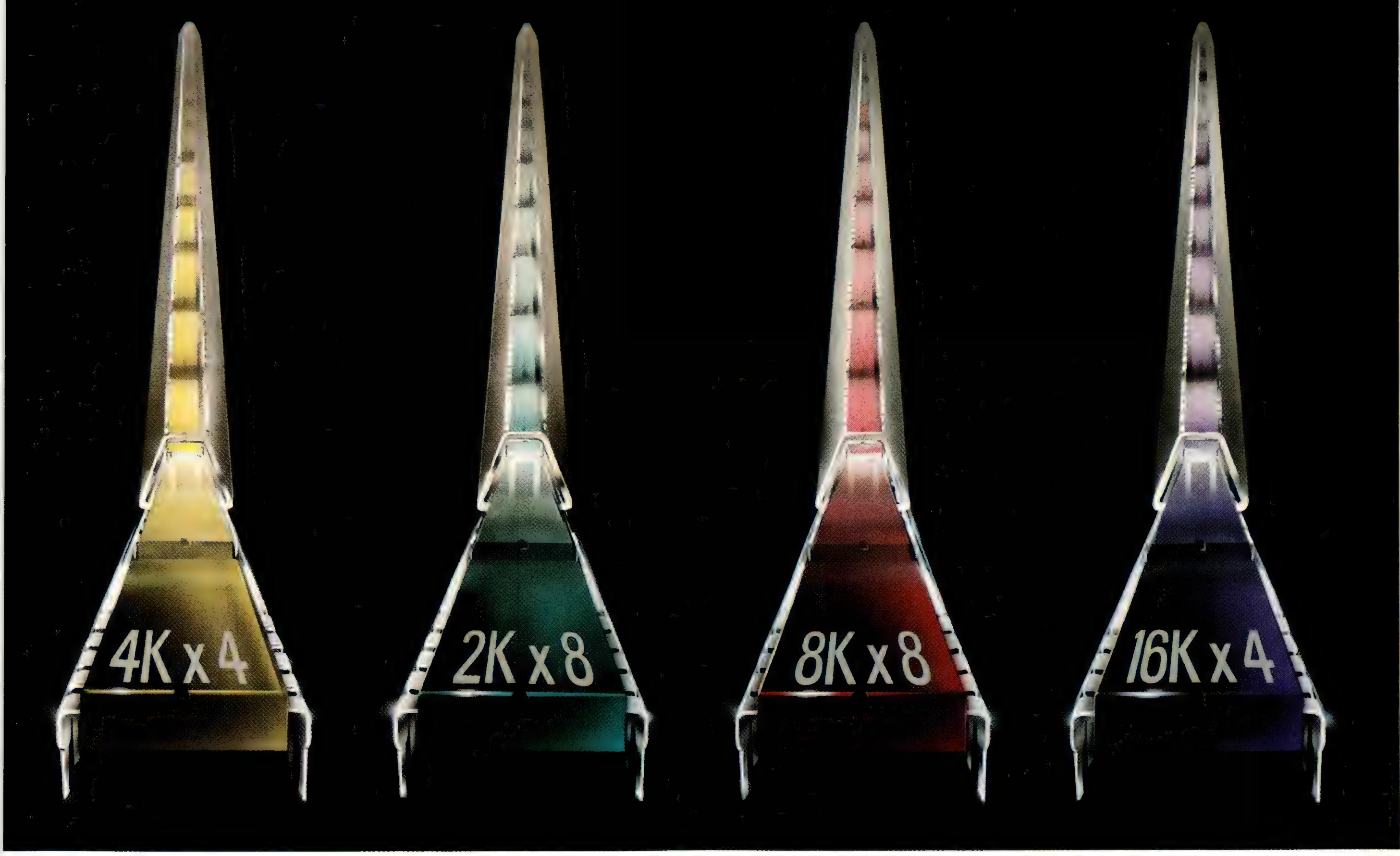
The second half of next year concerns Thomas Beaver, too. He is vice president and general manager of Motorola Inc.'s Microcomputer Division in Tempe, Ariz. Overall, the microcomputer business should grow some 30% next year, he believes, following up almost 40% growth this year. But most of that rise will probably come in the first half of the year. The latter half could be weak, because of all the uncertainties kicking around. Chief among these is the "impact of elections on capital spending and investment."

On the other hand, people have been predicting a recession for a while now, and it hasn't happened yet. "Most of us have been surprised that the economy has remained this strong for this long," says Thomas A. Vanderslice, chairman and chief executive officer at Apollo Computer Inc., Chelmsford, Mass. "Every six months we've been predicting that a drop-off would start six months out, but so far it hasn't happened. We see continued fast growth in our part of the business. Most forecasts suggest another 50% growth for work stations."

Another who doesn't see a downturn coming is Krehbiel of Molex. Molex is a broad-based company, serving markets from computers to home appliances and automotive components. The investment house of Salomon Brothers in New York is prominent among those predicting hard times, but Krehbiel isn't convinced. "Salomon Brothers have always been gloom-and-doom people," he says. "The picture looks good. I don't think it's booming, but it

PERFORMANCE

means 15ns wide word SCRAMs



15ns

SCRAMs are Static CMOS Random Access Memories from Performance Semiconductor. At 15ns address access time these 64K's and 16K's are the world's fastest. SCRAMs are manufactured in Performance's six inch class 1 fabrication facility using PACE II 0.7 micron gate length technology which has set the standard for memory speed.

There is immediate availability of 15ns 64K and 16K bit SCRAMs compatible with JEDEC standard pinouts. Also available from stock are 17, 20 and 25ns speed versions.

15NS SCRAM PRODUCT GUIDE

PART	CONFIG.	SPEED	AVAIL.
P4C164	8K x 8	15ns	NOW
P4C188	16K x 4	15ns	NOW
P4C198	16K x 4	15ns	NOW
P4C198A	16K x 4	15ns	NOW
P4C1982	16K x 4	15ns	NOW
P4C1981	16K x 4	15ns	NOW
P4C168	4K x 4	15ns	NOW
P4C169	4K x 4	15ns	NOW
P4C170	4K x 4	15ns	NOW
P4C1682	4K x 4	15ns	NOW
P4C1681	4K x 4	15ns	NOW
P4C116	2K x 8	15ns	NOW

FAST, COOL, & AFFORDABLE

For further information or to order 15ns SCRAMs call or write:
Performance Semiconductor
610 E. Weddell Drive,
Sunnyvale, CA 94089
Telephone: 408 734-9000

PERFORMANCE
SEMICONDUCTOR CORPORATION

Circle 63

PERFORMANCE

means 10ns sub-micron SCRAMs

10ns

SCRAMs are the world's fastest Static CMOS Random Access Memories at 64K and 4K bit densities. SCRAMs are manufactured in Performance's PACE II 0.7 micron gate length technology which has set the standard for memory speed.

There is immediate availability of the 10ns 64Kx1 and all 4K bit versions compatible with JEDEC standard pin-outs. In addition there is immediate availability of Performance's proprietary Cache-Tag 1Kx4 SRAM, P4C151, with user features including two cycle (flash) chip clear and 4-bit compare.

10NS SCRAM PRODUCT GUIDE

PART	CONFIG.	SPEED	AVAIL.
P4C187	64K x 1	10ns	NOW
P4C147	4K x 1	10ns	NOW
P4C148	1K x 4	10ns	NOW
P4C149	1K x 4	10ns	NOW
P4C150	1K x 4	10ns	NOW
P4C151	1K x 4	10ns	NOW

FAST, COOL & AFFORDABLE

For further information or to order 10ns SCRAMs call or write:

Performance Semiconductor
610 E. Weddell Drive
Sunnyvale, CA 94089
Telephone: 408 734-9000

PERFORMANCE
SEMICONDUCTOR CORPORATION

Circle 65

INTEL'S 80960 ARCHITECTURE IS THE SUPERHIGHWAY FOR EMBEDDED CONTROL.

66* MIPS by 1989. Over 100 MIPS in the 1990's.

At those speeds, Intel's new 80960 architecture is going to be miles ahead of other embedded control solutions. By enabling the execution of multiple instructions per clock, the 80960 architecture goes beyond simple RISC. Thus raising both the speed limit and your expectations.

But you don't have to wait to get on this virtual superhighway for embedded control. Because Intel offers a family of processors that you can drive away with today. All based on the 80960 architecture.

Starting with the 80960KB. The only 32-bit embedded control processor with a complete Floating-Point coprocessor. All on a single chip.

Then there's the 80960KA. A single chip 32-bit embedded control processor with a direct upgrade path to 66 MIPS in 1989. Available in more economical versions, without Floating-Point, at 16-, 20- and 25 MHz.

And for military applications, Intel offers the 80960MC. The only 32-bit embedded control processor with hardware multiprocessing capabilities on a single chip.

We also supply all the development support you need. Including high-level languages for a variety of industry-standard hosts, and the ICE™ 80960 development tool.

The result is the world's first fully supported 32-bit architecture designed exclusively for embedded control.

So why wait any longer? Our comprehensive 80960 brochure gives you the complete story. To receive it, just call (800) 548-4725 today and ask for Lit. Dept. #W475. With one phone call, your project can be on the road to 32-bit embedded control.

And ready to accelerate.

intel®

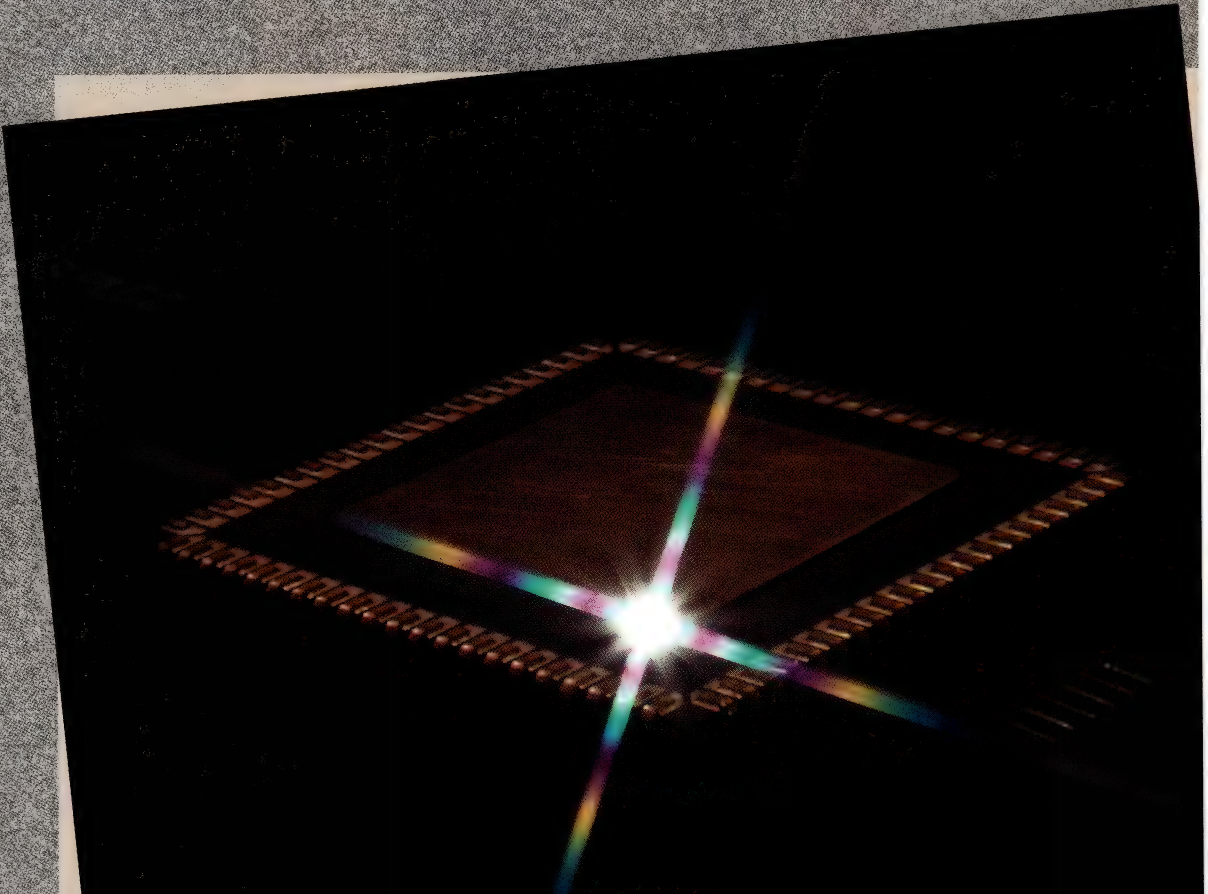
© 1988 Intel Corporation

*Sustainable MIPS on-chip.

Actel

Desktop Configurable, Channeled Gate Arrays:

The first no compromise, no wait ASIC solution.



Actel, inventor of the PLICE™ antifuse, offers the first family of desktop-configurable channeled gate arrays. Our CAE system, with fully automatic placement and routing and advanced in-circuit diagnostics, minimizes prototyping and design verification time. Both prototyping and production units are configured in minutes without expensive NRE.

You no longer have to accept the compromises and risks that plague traditional ASIC technologies—and wreak havoc on your design cycle, efficiency and creativity.

Traditional ASIC solutions demand that you compromise. If you opt for the density, performance and design flexibility offered by mask-programmable gate arrays, you have to accept prototype turnaround times of two, four, even eight weeks. You also have to risk tens of thousands of dollars in non-recurring engineering costs. On the other hand, if you opt for the desktop programmability and immediate turnaround of PLDs, you have to forgo high levels of integration and design flexibility.

Your options? You write off ASICs altogether. Or you compromise.

Actel's No Compromise ASIC Solution

Given what you have riding on the decision, Actel doesn't believe you should be forced to make such compromises. That's why we took a completely new approach to ASIC methodology. Rather than using device programming technologies borrowed from memory devices, Actel invented a whole new solution optimized for ASICs: the PLICE (Programmable Low Impedance Circuit Element) antifuse.

We combined our new programming technology with a channeled gate array architecture—a feat made possible by the small size and low resistance of the Actel-invented PLICE antifuse. Together, our PLICE antifuse technology and configurable gate array architecture form the foundation of a completely new ASIC solution.

Actel's No Wait ASIC Solution

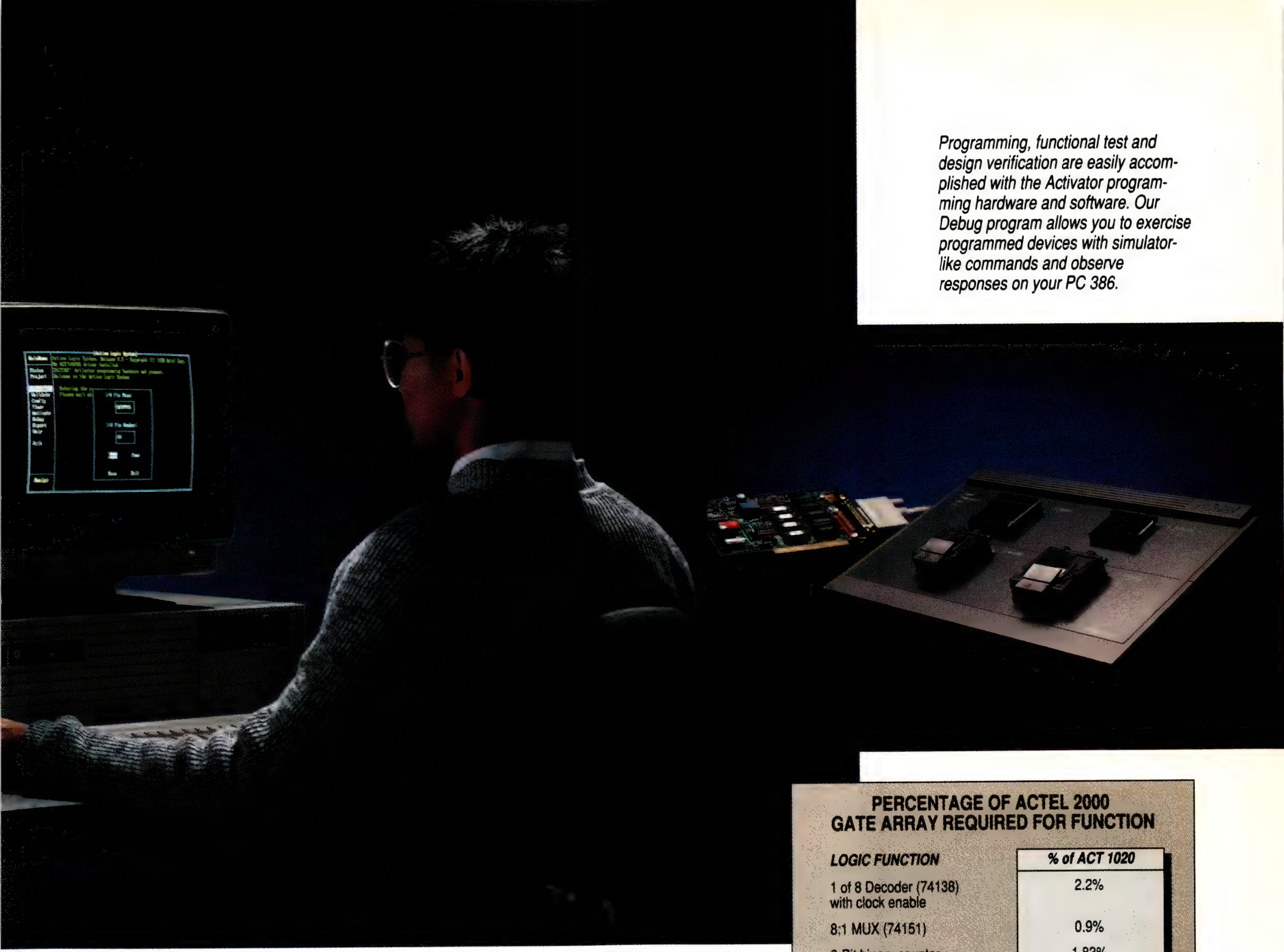
High gate-counts and application flexibility exhibited by channeled gate arrays stem from their significant interconnect resources—typically 90,000 potential interconnect sites in a 2,000-gate mask-programmed array.

By incorporating 186,000 antifuses on our 2,000-gate chip—roughly one hundred antifuses per gate of logic—we are able to offer a programmable device with design flexibility and interconnectivity comparable to a conventional masked gate array. What's more, ample interconnect resources and our channeled gate array architecture allow us to leverage years of algorithm development for placement and routing. We've developed a solution that fully automates the physical design process—increasing your productivity and reducing your time to market.

You can create gate array prototypes in a matter of hours. And you can finally afford to be innovative without fear of costly, time-consuming mistakes. In a nutshell, we offer you the first channeled gate array that lets you design, prototype and produce. On the spot. At your desk. With no NRE.

Actel's PLICE antifuse programming elements create low-resistance permanent connections. Their small size permits the incorporation of hundreds of thousands in a single chip making a desktop-configurable channeled gate array possible for the first time.

Programming, functional test and design verification are easily accomplished with the Activator programming hardware and software. Our Debug program allows you to exercise programmed devices with simulator-like commands and observe responses on your PC 386.



Our Action Logic System gives you a familiar macro-based gate array design environment running on a PC 386. As a complete desktop development system, it includes everything from schematic capture, electrical rule checking and simulation to completely automatic placement and routing with post-route timing analysis.

PERCENTAGE OF ACTEL 2000 GATE ARRAY REQUIRED FOR FUNCTION

LOGIC FUNCTION	*% of ACT 1020*
1 of 8 Decoder (74138) with clock enable	2.2%
8:1 MUX (74151)	0.9%
3-Bit binary counter, reset & clock enable	1.83%
8-Bit serial to parallel shift register with reset	2.9%

Our Action Logic System algorithms provide you 100 percent automatic placement and routing, and device utilization levels from 85 to 95 percent—completely eliminating time-consuming manual placement and routing.

Immediate Programming With The Activator

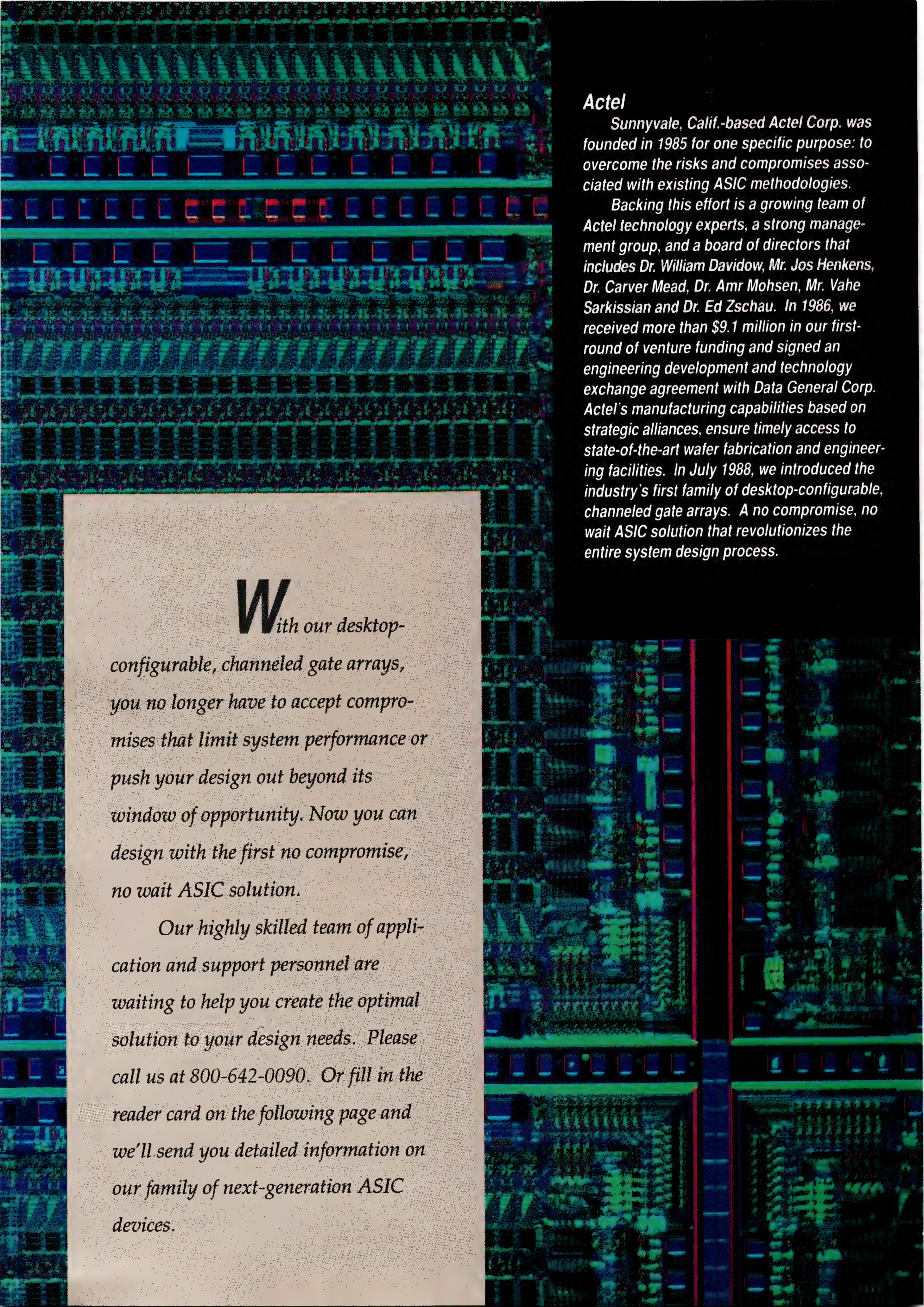
Best of all, ACT 1 devices are programmed on your desktop using our proprietary Activator, a hardware and software system used for programming and functionally testing the chips you've designed on our Action Logic System.

Creating programmed devices is a quick process. For example, a 1,200-gate Actel array is placed, routed and programmed in less than one hour. So you no longer have to accept the two- to eight-week turnaround time that burdens use of mask-programmable gate arrays.

ACT 1 ARRAY CHARACTERISTICS

	1988		1989	
DEVICE	***ACT 1010***	***ACT 1020***	***ACT 1230***	***ACT 1260***
Gate array gates	1200	2000	3000	6000
CMOS process	2 micron	2 micron	1.2 micron	1.2 micron
Logic modules	295	546	720	1404
Max D flip-flops	147	273	540	1052
Max latches	295	546	700	1400
PLICE anti-fuses	112,000	186,000	333,000	666,000
PLICE s/gate	93	93	111	111
I/Os	57	69	108	150

Because our channeled gate array architecture allows extension to ever higher densities, you can be assured of a migration path for future design requirements.



Actel

Sunnyvale, Calif.-based Actel Corp. was founded in 1985 for one specific purpose: to overcome the risks and compromises associated with existing ASIC methodologies.

Backing this effort is a growing team of Actel technology experts, a strong management group, and a board of directors that includes Dr. William Davidow, Mr. Jos Henkens, Dr. Carver Mead, Dr. Amr Mohsen, Mr. Vahe Sarkissian and Dr. Ed Zschau. In 1986, we received more than $9.1 million in our first-round of venture funding and signed an engineering development and technology exchange agreement with Data General Corp. Actel's manufacturing capabilities based on strategic alliances, ensure timely access to state-of-the-art wafer fabrication and engineering facilities. In July 1988, we introduced the industry's first family of desktop-configurable, channeled gate arrays. A no compromise, no wait ASIC solution that revolutionizes the entire system design process.

With our desktop-configurable, channeled gate arrays, you no longer have to accept compromises that limit system performance or push your design out beyond its window of opportunity. Now you can design with the first no compromise, no wait ASIC solution.

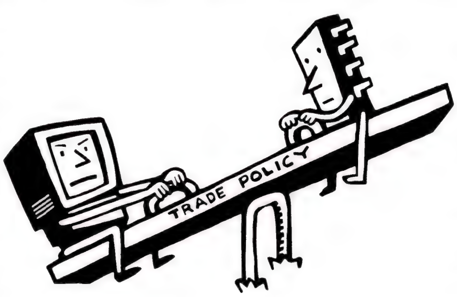
Our highly skilled team of application and support personnel are waiting to help you create the optimal solution to your design needs. Please call us at 800-642-0090. Or fill in the reader card on the following page and we'll send you detailed information on our family of next-generation ASIC devices.

where there must be a drought somewhere in the world . . .” Since the mid-1970s, Bolan feels, the users of semiconductors have been the big winners, while chip suppliers suffered in the market's wild ups and downs. “Every dollar they made in the good times, they eventually lost, because it was a fixed-cost business.”

How can international trade policies be set to help chip makers without hurting the chip users? It's an issue that the new administration in Washington is going to have to come to grips with, says Cherry of Cherry Corp. Although he is a big believer in free trade, Krehbiel of Molex says that in cases of unfair competition, the U. S. should fight fire with fire. Europe, for example, is getting together in a common market “that is going to have a lot of restrictions which I'm sure will penalize countries like the U. S.” He feels that if executives in U. S. industry cannot unite behind strong countermeasures, “we're all going to get hurt.”

Stata of Analog Devices is another believer in government action. “In the short term, it's appropriate and desirable that the U. S. government take a position similar to Japan in protecting emerging industries or markets. High-definition TV is a case in point,” he says. “The U. S. government would be totally justified in making sure that the country doesn't lose out in that emerging market.” Over the long term, “the government can also help by subsidizing education and research in some way to offset the risks of investing in new technology,” says Stata.

Many executives feel, however, that the government should come to grips with the issue by letting loose and standing back. “I subscribe to the theory that if you keep pace with technology, that's better than getting help from the government,” says Beaver of Motorola. FileNet's Smith shares the view. Having the government negotiate with foreign countries “is not the way to deal with it,” he says. “If we don't have advanced technology positions, politics won't do the job.”



Other managers point out that the political process often doesn't result in the exercise of good judgement. “Various interest groups have lobbies in Washington, and you see judgements being made, and sometimes legislation, which responds to [the lobbying], but which can dislocate other parts of the same industry,” says Currie, referring again the U. S.-Japan DRAM pact. He thinks that current lobbies who want to prevent U. S. industry from using the Chinese Long March rocket to launch satellites may end up hurting the U. S. satellite industry, for another example.

“We need balance in how these judgements are made,” Currie says. “Often it's Washington that goes off half-cocked in one direction or another.”

MUST GALVANIZE. But he doesn't know how that balance can be achieved. Executives agree, however, that the country can't just sit still. “Somehow, we've got to galvanize ourselves,” says Cherry. The only way he sees that happening is with a high government official, perhaps a Secretary of Defense or Commerce, stepping forward and taking the lead.

That official would have to convince both sides of the industry that a unified approach to trade policy is crucial. “I think if you sell this with enough emphasis, you could get business united behind it,” says Krehbiel of Molex. “I just don't think that each businessman has been hit with enough information to give him the idea that this can hurt him too.”

“We can do more,” says Cherry. “But I expect that in hindsight we'll see that we've made enormous progress in the past few years.” The industry has done this, he feels, “just by focusing on it more.” □

EUROPEAN EXECUTIVES PRESS THEIR HOME-COURT ADVANTAGE

Executives at European electronics companies are keeping a close eye on special market opportunities close to home, especially in the telecommunications and consumer segments. They see these opportunities emerging for products that for the most part will not be salable outside Europe due to unique European standards, but also for some products that are being driven by European cooperative-research efforts.

One big factor creating the opportunities is the coming pan-European market. National trade barriers are scheduled to disappear in 1992, setting up a large, unified market. The toughest part of this job may be reaching agreements on pan-European technical standards which would make each product marketable throughout the region. But such standards will come too, although more slowly than the proposed changes in the tariff laws.

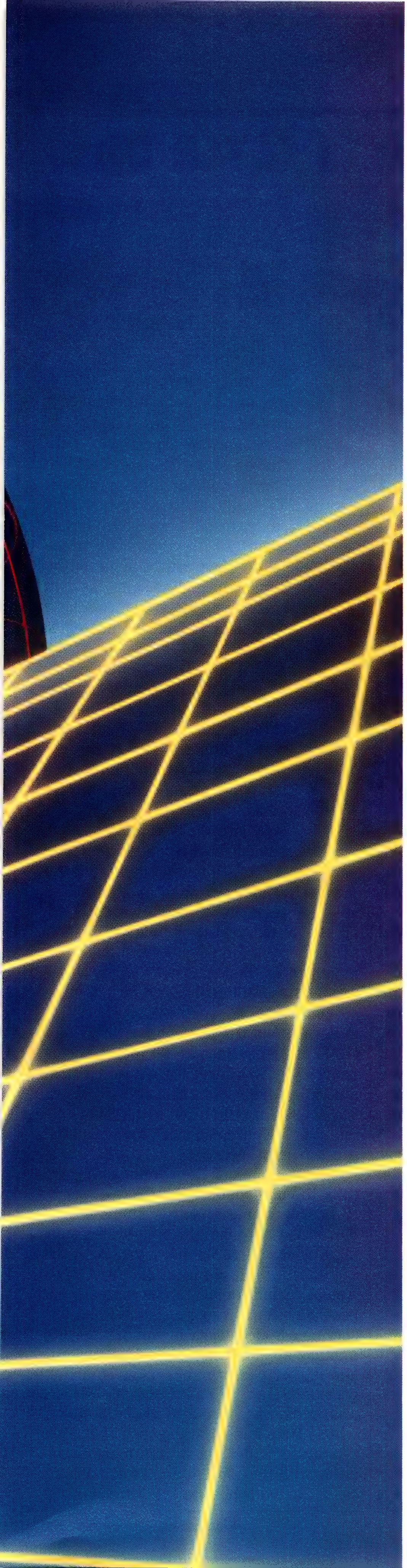
Knocking down the barriers will obviously be beneficial to markets that are inherently international—a cellular telephone that only works in one country is of limited use in Europe, where border-crossing is commonplace. A pan-European mobile cellular-phone network is now in the works, with trials set for 1991.

“Telecommunications has got to be the most important area for Europe,” says Gerry Thomas, president of LSI Logic Europe plc and managing director of LSI Logic UK Ltd., both based in Great Britain. Doug Dunn, the managing director of Plessey Semiconductors, in Swindon, UK, agrees. The digital form of cellular telephony in particular will take off in the early 1990s, he predicts.

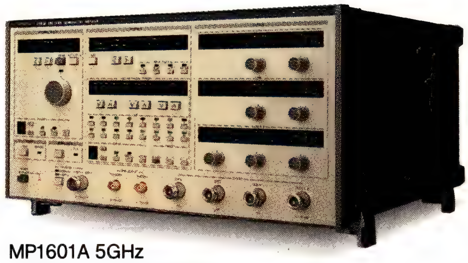
In addition, consumer products, particularly high-definition and direct-broadcast satellite television, will be technology drivers in the future, although further out than next year, says Dunn.

On the Continent, Sönke Mehrgardt, director for business development and concept engineering at the ITT Semiconductors Group in Freiburg, West Germany, is keyed in on consumer electronics, particularly TV, as an area offering rich opportunities for European companies. Satellite TV broadcast standards are being implemented, he says, and “This will develop into a big market.” Mehrgardt also sees stereo, digital audio, and video equipment markets taking off.

There are other markets being seeded by the European Community organization, points out Plessey's Dunn. Translation systems for telephone exchanges is an example; another is vehicle guidance systems. “These new projects in Europe allow us all to get off to an even start,” he says. “There is no doubt that [non-European manufacturers] will participate in these markets, but we will start on a level playing field.” Non-European vendors have advantages in such areas as memories and microprocessor chips, but such capabilities “will not necessarily bring any advantage with some of the new system technologies that are being driven by programs such as Esprit,” says Dunn.



RELIABLE SUPPORT FOR ISDN



MP1601A 5GHz
Pulse Pattern Generator

Surviving in the complex and competitive world of ISDN will depend on vital problem-solving capabilities like quick response, quick recovery and preventive checking. This requires comprehensive monitoring, rigorous testing and exacting quality control of transmission systems.

Anritsu's accuracy, quality and reliability are based on decades of experience in electronics, optical technology and laser research. Our focus is on the advanced optical devices and test equipment necessary for ISDN.

Anritsu excels in optical and digital communication test systems. We have shown our commitment to quick response to practical ISDN applications by introducing high-resolution OTDRs, 5GHz pulse pattern generators, high-performance error rate measuring equipment for digital transmissions, and many more.

Anritsu also designs industrial automation systems, applying lasers in many new ways. Feedback from every area enables us to develop ground-breaking new products.

For any network, one name provides the reliable support to keep it running smoother...

Anritsu makes you a survivor.

Anritsu

ANRITSU CORPORATION
10-27, Minamiazabu 5-chome, Minato-ku, Tokyo 106, Japan
Phone: Tokyo 03-446-1111, Telex: 0-242-2353 ANRITU J

Circle 81

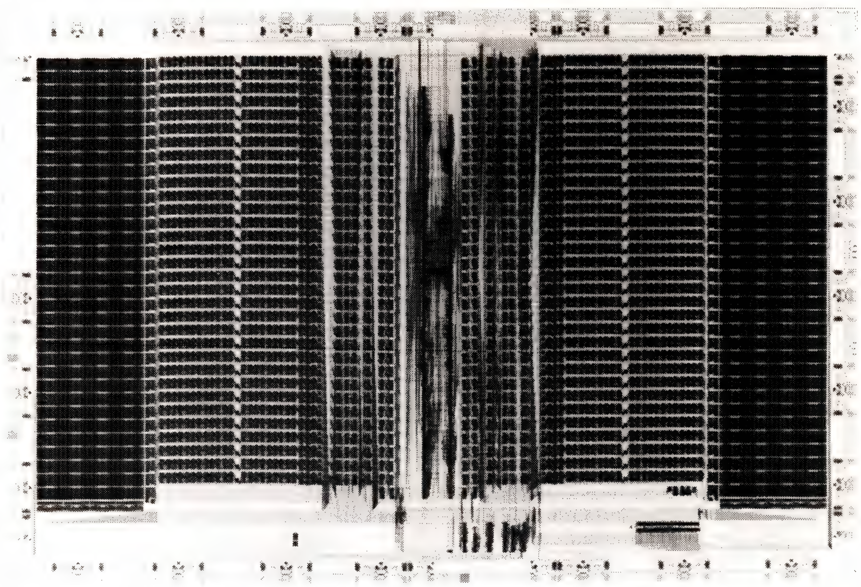
on standard monolithic CAMs to proliferate throughout systems ranging from personal computers to mainframes."

Another company, Microcirc Associates in Newport Beach, Calif., furnishes custom CAMs as part of its overall business, which is building custom memory chips for aerospace and military system houses. Over the past few years, says Tegze Haraszti, Microcirc's president, the company has developed a number of CAM designs for aerospace applications. Among them are 4-K-by-1-bit and 4-K-by-4-bit CAMs that are capable of access times as fast as 3.4 μs and clock speeds as high as 200 to 300 MHz.

At the moment, however, chip-company activity is little more than a few firms that keep eyeing the CAM market, tentatively circling the concept like someone kicking the tires on an automobile before he'll buy it. Those companies include Inmos, Integrated Device Technology, Micron Technology, Mosel, and Vitelic. All of them have evaluated the market for CAMs. They have even designed prototypes. But so far they have all ended up postponing any decision to actually produce a device in volume and send it out into the market.

Two problems keep them hesitant, says Doug Mitchell, director of marketing at Inmos in Colorado Springs, Colo. One is defining a CAM architecture with sufficiently broad market appeal to make it economically competitive with standard commodity SRAMs or DRAMs on a cost-per-bit basis. The second is defining an architecture that addresses a specific market niche with a sufficiently high average selling price to justify the cost of fabricating the parts. "Most of the players in the application-specific memory area need to know that there is a very specific market with a well-defined set of needs before they will proceed," says James T. Koo, a vice president at Vitelic Corp., San Jose, Calif. "It takes a lot of courage to develop a part that you think might be very popular and then just throw it out there and see who uses it. At a large company, if you guess wrong it means you lose your job. At a small startup, you could lose the company."

What is required to open up the market for CAMs, says AMD's Naskar, is a change in viewpoint on the part of both memory suppliers and users. They need to stop looking upon memories in general and CAMs in particular as storage devices, and instead begin to view them as logic replacements. It is true that memories are passive devices that store data, rather than active devices that operate on data. But Naskar says that memories can nonetheless be used to design many useful logic functions. Looked at in this context, a memory is seen as a system building block that provides for the compact storage of a large number of states.



NEC Corp.'s CAM-based character-string-search engine, developed for in-house use, can compare in 50 ns text strings input at 10 million characters/s.

And in this context, he says, CAMs are best viewed as pattern-recognition devices. As such, he says, they should find wide use in LANs, disk cache, data-base search and retrieval, and image processing, as well as in a wide variety of artificial-intelligence applications. "The key is finding one or more applications with sufficient volume to justify such a specialized architecture," Naskar says, "and which could be used as a point of leverage, economically, to allow the development of similar devices for a variety of lower-volume market segments.

To open up the market, users must see CAMs as logic replacements

In effect, Naskar says, AMD with its CAM products initially targeted at LANs is in the position that Intel and a few other companies were during the early seventies, when they had come up with the first semiconductor-based SRAMs and DRAMs. "After a number of attempts in various sizes, configurations, and features, a few companies came up with ICs that they knew would fit a few very specific system applications. But once the systems designers got hold of them, they ended up in applications no one had even thought of. And a new market was born."

FOR CACHES. So far, the closest that most memory makers have come to CAMs as a standalone standard product, says Vitelic's Koo, is in cache-memory design. In such designs, a subset of fully associative CAM technique, called set-associative mapping, is being implemented as a way of speeding up system response time and eliminating the speed gap between the central processing unit and main memory [*Electronics*, June 11, 1987, p. 78].

The set-associative cache now being used instead of fully associative CAM borrows from a software technique for simulating an associative memory, called hash coding. In hash coding, the memory address space is divided into a number of sets of words. Ideally, each set has no more than one word of most-frequently-used data. In set-associative cache-tag RAMs and controllers, multiple banks of SRAM are allocated on a least-recently-used basis. To increase the hit rate, the rate at which there is a successful matching between what is in cache and what is in main memory, the designer increases the number of sets. Early direct-mapping schemes were based on a single set, while more recent cache memories and controllers use two- and three-way set-associative schemes. The result, says Koo, is that in most cache applications in microprocessor-based systems, set-associative schemes act exactly like true associative-memory-based CAMs, except for some restrictions on accepting new entries. The restrictions revolve around how closely the new entries resemble the entries already present, so as to avoid contention.

Koo says cache memory is a promising application for a fully associative CAM, but several factors combine to make it impractical. For one, performing the search and compare operations imposes an unacceptable overhead. For another, the address comparator required varies from system to system, making it difficult to come up with a completely generic, fully associative cache-tag memory.

In the absence of standard CAM parts from IC makers, users are taking matters into their own hands. Many have developed their own, system-specific custom implementations.

AMD's CAM BREAKS LAN-BRIDGE BOTTLENECK

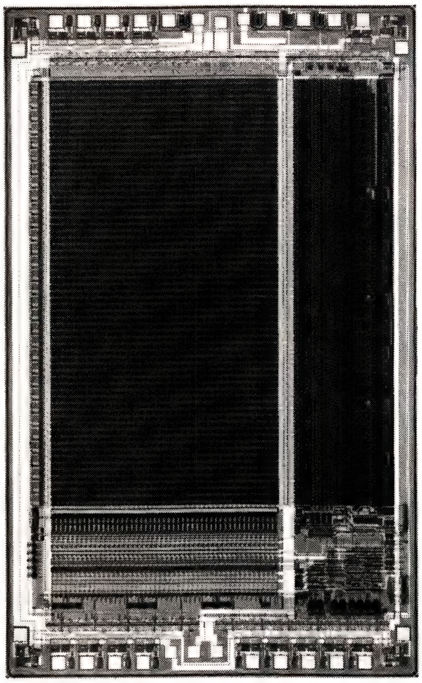
A new kind of memory is being put to use in an Advanced Micro Devices Inc. device that could break bottlenecks in local-area networking applications. The Am99C10 is an application-specific content-addressable memory that outperforms the embedded controllers and reduced-instruction-set processors now proposed as a way to implement LAN functions such as bridges, repeaters, gateways, and routers.

Content-addressable memories are attracting a lot of attention these days because they offer more speed and flexibility in a number of applications compared to conventional random-access memories (see p. 82). Unlike RAMs, which search for an address, decode that address, and select a particular group or word from it, CAMs search for contents—specific information that may be located anywhere in a memory array—says David Wyland, director of product planning and applications at AMD's Specialty Memory Division in Santa Clara, Calif. Moreover, they can search multiple addresses in parallel.

The Am99C10 can compare, in parallel, a 48-bit input word against 256 words stored in the array, taking just one 100-ns cycle to do so. Used as an address filter in a local-area network, the device can outperform an embedded 40-ns, 32-bit RISC processor operating at 40 MHz. To perform a search-and-compare operation of equivalent size, says field applications engineer David Sorensen, the RISC processor would take at least two 32-bit instruction cycles for a 48-bit word. At 40 ns, searching the array in sequence would require a total of 20.5 μs.

That means even a high-performance RISC processor becomes a bottleneck in many LAN applications, where a typical bridge has as many as 16,000 addresses to match and compare. By cascading multiple CAMs together, on the other hand, any number of addresses can be searched and compared in the same 100-ns cycle. The only limitations are cost and space.

The Am99C10 is fabricated in 1.5-μm CMOS. It is built around an array of 12,288 identical cells, each consisting of a traditional four-transistor static RAM cell and special comparison-logic circuitry. This array is organized into a bank of 256 logic comparators, each 48 bits wide. Associated with each 48-bit comparator is a 48-bit register. Supporting the operation of the array are a multiplexer/demultiplexer, a priority encoder, special mask logic, a comparand register, matching logic, and status and command registers. The internal data bus is 48 bits wide. External communications are done over a 16-bit bidirectional bus.



The Am99C10 compares a 48-bit input word against 256 words in one 100-ns cycle.

Data is loaded into the comparand register via the external data bus through the multiplexer and presented to the CAM array, which performs simultaneous compare operations on all data (256 words) in a single cycle. When the comparand and a word in the CAM are matched, the on-chip priority encoder generates a match-word address identifying the location of the data in the CAM. If multiple matches occur, the encoder generates the lowest matched address. Any or all bits of the compared value can be selectively masked, says Wyland, and those masked bits are not used in the compare decisions, allowing comparisons even on portions of a data word. The user can read and write to any location in the CAM array and to all of the device registers.

SKIP AND EMPTY. Adjacent to the CAM array is a special skip- or empty-state information memory block, organized as 256 words by two bits. This gives each 48-bit word in the CAM a skip and an empty bit associated with it. The skip bit enables or disables a word in the CAM in situations where there are multiple matches, while the empty bit indicates available or empty addresses in the CAM into which data can be written.

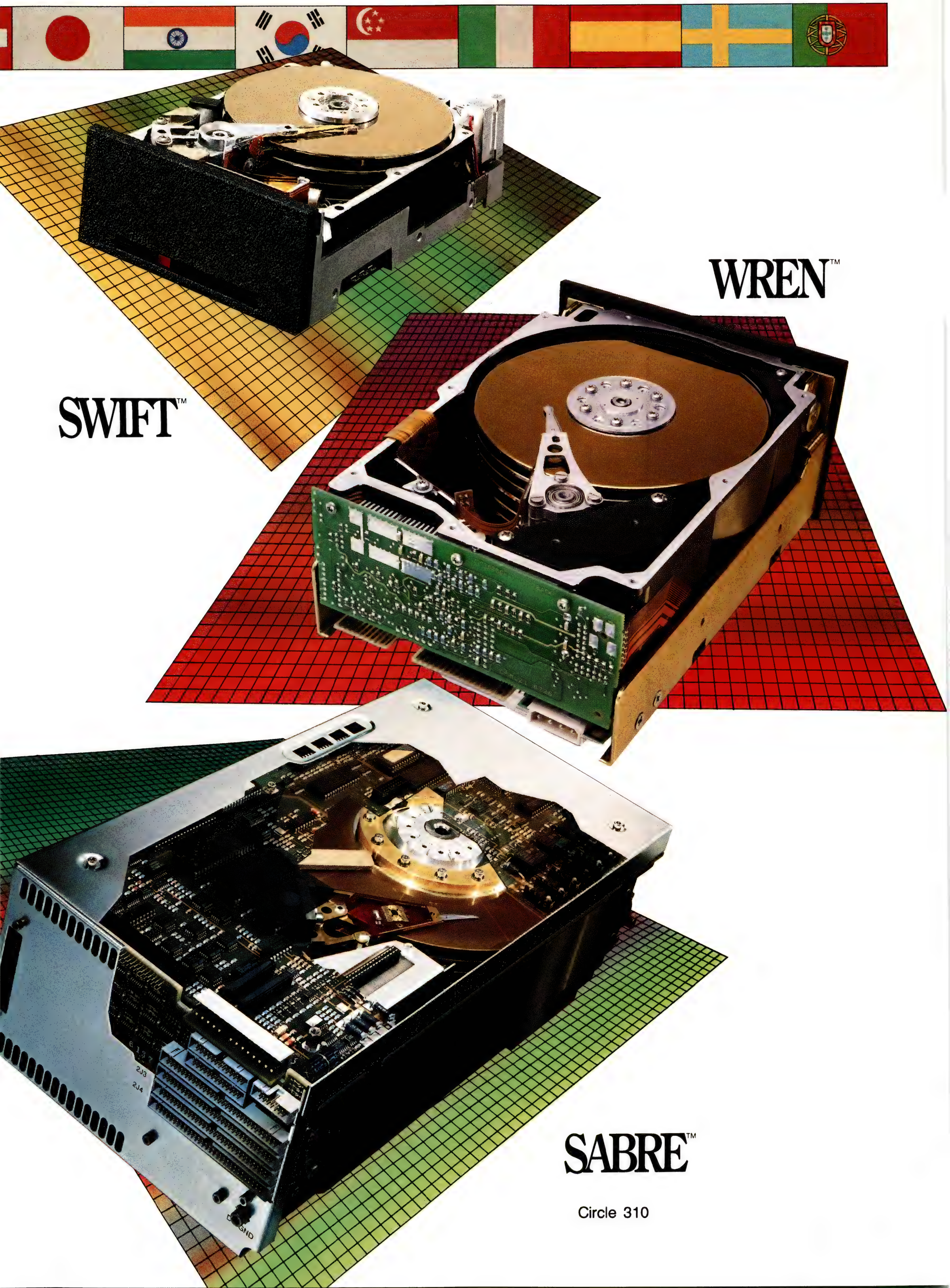
With its 48-bit-wide architecture, the Am99C10 is ideally configured to replace high-speed, high-power TTL or emitter-coupled logic or embedded RISC machines, says Richard Burg, AMD's marketing manager for specialty memory products, not only in network bridges but also in related functions such as repeaters, routers and gateways, all of which allow network designers to tie together different kinds of LANs that run at different speeds.

Bridges serve to increase the distances over which LANs can operate and also provide such functions as frame storing and forwarding. A CAM used as a high-speed filter in a bridge compares all the incoming addresses in a frame with the address data stored in the array, and indicates whether there is a match or not. If there is a match, the CAM then forwards the frame. With a 100-ns match and compare time, a bridge built around an Am99C10 looks like a single network, even for high-speed Fiber Distributed Data Interchange configurations—their 20-μs packet time is a snail's pace compared with the operation of the CAM.

Beyond the LAN-specific Am99C10, Wyland says, AMD expects to expand its CAM product line in a number of different directions, depending on market demand. Some of the variations being considered include different word sizes, as well as deeper and larger arrays for use in other LAN configurations, and CAMs adapted for a variety of other application niches.

Among the broad application areas that should find wide use for the Am99C10, says Wyland, is in systems where the primary concern is data-base management. Most current data-base solutions are software based, in which an applications program for text or data retrieval is used to search, compare, and retrieve data based on key words and data. These keys are then compared to the contents in mass-storage media or to an index of that information. Being proposed by a number of designers is the use of a data-base machine or disk-cache block between the central processing unit and the data base. The purpose of such a subsystem, says Wyland, is to take over the time-consuming data-base computations and the search functions. A key element in such a subsystem would be content-addressable memory elements such as the Am99C10. CAMs allow searches to be performed much faster in hardware, taking advantage of the fact that searches can be performed in parallel, rather than in sequence.

Available now in sample quantities for $42 each, the Am99C10 is scheduled for full production in April 1989. Also in development is a 70-ns version, fabricated by the company's next-generation 1.0-μm CMOS process. *–Bernard C. Cole*

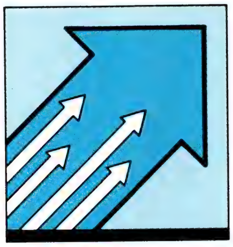


Circle 310

MCC, AFTER FIVE YEARS OF R&D, REFOCUSES TO EARN ITS KEEP

Consortium aims to deliver more usable prototypes and resets late-1990s technology goals

by J. Robert Lineback



Times are changing for the pioneering U. S. research consortium, Microelectronics and Computer Technology Corp., reflecting the changes in the industry between 1983 and 1988. It's also a sign of MCC's age. As it celebrates five years of work this month in Austin, Texas, its top executives are working to realign the consortium's efforts to the changing demands of today's markets and the shifting needs of its shareholder companies.

The story was quite different five years ago. The electronics industry leaders who formed MCC envisioned it as a technology think tank, a way to present a united front against the challenge of Japan's fifth-generation computer project. Their main worry was whether or not the highly competitive companies that made up the consortium could cooperate in long-range research.

They could, and they have. Now, the big question is how MCC can get more of the technology it is developing into the products of its sponsoring corporations. The MCC leaders also want to make sure the consortium's long-range strategic research efforts are aimed at the right new technologies for the turn of the century. At the same time, they have to continually evaluate how the organization should be supported, and they must make sure that MCC continues to maintain its shareholders' allegiance.

Several factors are driving the changes. For one thing, MCC has been around long enough so that its executives—and its members—feel it ought to be spinning off some usable technology as it continues to pursue long-term projects. For another, technology has changed, and MCC needs to make sure its projects change accordingly. Finally, concern over the impact of the Japanese fifth-generation project has declined, a circumstance that allows MCC to set its sights on emerging issues.

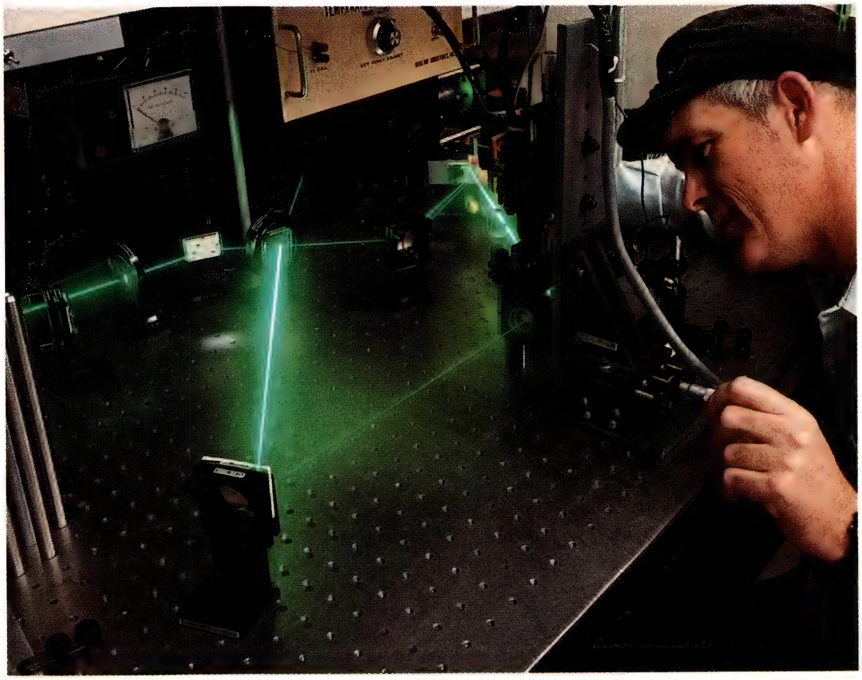
"What I have been trying to emphasize is we are in the fifth year in three of our programs and the fourth year of another program," says Grant A. Dove, chairman and chief executive officer of MCC. (The first three programs are packaging and interconnection, advanced computer architecture, and computer-aided design; the fourth program is software.) "There are some interim milestones that are producing very useful results. Let's get them out, and let's get them to work," Dove says.

Since taking over from B. R. (Bobby) Inman in the summer of 1987, he has gradually been restructuring the research programs. The packaging and interconnection, advanced computer architecture, and CAD programs have been completely reorganized. Each now consists of a core technology unit working toward long-range technology goals, plus several satellite projects. The satellites are supposed to produce ongoing results the shareholder companies can use, by periodically spinning off prototypes, interim technologies, and experimental systems that can be used in the shareholders' products.

THE HAND-OFF. The changes Dove is making are, in fact, at least partly in response to what Inman predicted in the early days of MCC would be the consortium's most difficult task: handing off its technology to the member companies. This is not to say MCC's technology has been sitting idle in the lab. To date, more than 70 original technology transfers (not upgrades) have been made starting in 1985. Officials in Austin, Texas, where MCC is headquartered, say the number will pass 90 before the end of the year. The consortium has also produced 1,150 reports since 1984 and filed for 31 patents.

The final weeks of the year will see a flurry of technology transfers. This month, for example, the computer architecture program will bundle and ship for the first time a complete set of its tools in HITS, for human interface tools. HITS is aimed at allowing rapid design and implementation of multimodal computer interfaces. Also in December, a substantially faster version of MCC's Proteus knowledge-based system, version III, will be shipped to sponsoring shareholders.

Next year, the computer program plans to transfer a parallel-processing version of its data-base query language, called Logic Data Language, which is a superset infusion of the data-base programming language SQL and artificial intelligence's Prolog. LDL will be able to compile an intermediate language that



MCC researcher works on Bobcat, a bench-top version of a planned hologram-based data storage system developed by the consortium's advanced computer architecture program.

are ahead. First is that the distributed software challenge is spreading into many corners of corporate America. That means large companies will have to create software specifically for their business requirements—few of them will be able to use off-the-shelf software. Second, his software group will soon have to start applying some of the more traditional computer sciences and methodologies to the rather unconventional practices that have been employed up until now in the program's upstream automation efforts.

MCC's packaging program has undergone a complete change in focus in recent years—from an emphasis just on performance to one of low-costs breakthroughs.

Besides the changes to individual programs, MCC is also deeply involved in putting together a new strategic plan on both business and technology fronts. Among the changes being considered is a proposal to form an MCC subsidiary that would take technology from its labs and, on a contract basis, develop marketable products—another approach to the problem of handing off its work to the sponsoring companies. And to expand its immediate research base and possibly attract new members, MCC is now proposing to launch a new optical computing technology program which would focus on the use of light-based systems to selectively break the speed bottlenecks of advanced computer architectures (see p. 93). Finally, look for MCC to take on more government work in the coming months.

FINDING FUNDING. The government projects raise another of the issues MCC is dealing with—how to support the work it does. Government contracts are a temptation, but Dove is determined to keep the bulk of MCC funding squarely in the free enterprise corner. The consortium's annual budget is now between $65 million and $70 million, Dove says, and he hopes to keep the full-shareholder membership at about 18 to 20 companies.

However, MCC did depart this year from its past policy of not bidding on government contracts at all. It received funds from the U. S. Defense Advanced Research Project Agency for a Lego-like computer-prototyping system called Experimental Systems Kit [*Electronics,* Feb. 18, 1988, p. 37]. Today, it is also pursuing DARPA and other federal agency money with its optics technology efforts.

The task of funding MCC goes hand-in-hand with the task of maintaining its members' support. Without the allegiance of the shareholders, the question of how to pay for the programs is moot.

Under MCC's bylaws, a member company that wants to drop out of the consortium must give notice in December that it will leave at the end of the following year. No members gave notice last December, so MCC lost none this year. A handful had left in 1986 and 1987, mostly because of mergers and changing corporate focus. Generally speaking, new members came in to replace those that departed. No one wants to talk about whether any members will give notice this month that they plan to leave in 1989, but the MCC executives seem to be bracing for some notices to arrive. "Don't be surprised to see some ups and downs as we [make the] transition into next year," cautions Dove.

The 19 members of MCC are: Advanced Micro Devices, Bellcore, Boeing, Control Data, Digital Equipment, Eastman Kodak, General Electric, Harris, Hewlett-Packard, Honeywell, Hughes Aircraft, Lockheed (which is inactive), Martin Marietta, 3M, Motorola, National Semiconductor, NCR, Rockwell, and Westinghouse. Most of them decline to comment on their future plans, although many say they stand steadfast behind the MCC concept. "MCC has been successful. The quality of research being done is the major thing," says Robert M. White, chief technical officer and vice president of research and engineering at Control Data Corp. in Minneapolis.

Another steady supporter is Digital Equipment Corp. in Maynard, Mass. "MCC was one of the first consortia in this country. It was an experiment to determine if U. S. companies could pull together to advance technology," says Sharon Lipp, senior manager of the Technology Development Program at DEC's corporate research operation. "It's been bumpy, but we've all learned a lot."

At least one new MCC member is talking about expanding its support. Hughes Aircraft is so impressed with the results from MCC's packaging lab that it is planning to broaden its participation in the program into more of the satellite efforts. "We talk the same language," says Karl H. Reissmueller, a vice president in the Industrial Electronics Group at Hughes and manager of the Microelectronics Circuits Division in Newport Beach, Calif. Still, MCC's challenges go well beyond the evolution of electronics markets. The most-often-used word by MCC officials to describe the consortium's current state is "adolescence."

"We are clearly coming out of a growth phase—probably a year ago we starting doing that," Pinkston says. "Now we are in a period of taking stock. It is going to be a period of some changes and an examination of just how things have been working.

"Are all of the premises that it was formed on still valid?" Pinkston asks. "The answer is no, they are not all still valid. Now, how do we react to the changing world, how do we react to the lessons learned about what works and what does not?"

Looking back, Pinkston says one major change for MCC has been the level of corporate interaction with the consortium. "It was formed by CEOs on the basis of the announced Japanese initiatives. CEOs are statesmanlike visionaries who can say their companies are going to push ahead," he says. "The programs were put together, and they did a good job because there has not been a lot of varying from what they thought was important. However, over the years, CEOs of course have other problems to deal with. So responsibility for managing a company's interest migrated downward in many of the shareholders to the managers of profit-and-loss centers who must remain focused on substantially near-term issues. And at the same time our age also dictates that we should be moving into a phase in our programs where we should be producing deliverable results.

"It continues to be a challenging time, and we have not seen the last crisis," Pinkston says. "But I'm convinced it is the right thing, and the way to deliver substantial value that would not otherwise happen."

Additional reporting by Lawrence Curran, Wes Iversen, and Larry Waller cult to produce, and they still fell short of needed bit densities to make such an optical subsystem competitive with existing technologies. Furthermore, the process of reading holograms of data disturbed or actually erased bits.

To overcome the data-retention problem, MCC developed what officials say is a novel nondestructive readout technique using a combination of an applied electric field and polarized light. The asymmetric write/read technique creates a data-storage hologram that requires more energy to erase than it took to record it in the first place.

To improve the photorefractive medium, MCC scientists—along with reseachers at Stanford University in Palo Alto, Calif.—developed a new technique for making crystal fibers that can be used in an array to replace conventional bulk crystals. The fibers, measuring about half a millimeter in diameter, are made of strontium barium niobate grown from seed material with the heat of lasers. Whiskers of SBN called crystallites are potentially much easier to manufacture in volume than large-diameter bulk photorefractive crystals are, says Redfield, and the isolation of fibers in an array also allows for greater control of applied fields in the storage medium. MCC officials believe its lab was the first to demonstrate photorefractive holographic recording on crystal fibers.

BOBCAT II. In the next phase of research, MCC's optics lab plans to build a prototype of a volume-holographic storage subsystem, matching the size and shape of standard 5.25-in. disk drives. The prototype—dubbed Bobcat II—will use a 30-by-30-fiber array of the SBN crystallites and the new nondestructive readout technique. The target is to have a 10-μs read latency, a 100-μs write time, and an initial capacity of 100 Mbytes. Researchers expect the storage capacity to increase with improvements in the system, particularly advances in spatial light modulators, which are used to convert electrical information into a 2-D array of spots. A hologram of the Fourier transform of this array is actually stored in the crystal to keep the recording area small and help overcome any defects in the material. The lab plans to design the Bobcat II prototype so that it fits in a storage hierarchy between disk and semiconductor-based main storage.

The immediate work ahead will be focused on characterizing density potential, error rates, and how well the fiber array will guard against crosstalk and interference compared to bulk material. Early experiments have already shown that with the nondestructive-access writing technique, fibers are able to retain data for more than six hours of continuous reads, a time that is roughly equal to a billion short laser pulses.

"There are no moving parts, and it would be radiation-hard. Those are two things—besides the speed—that really excite me," says Pinkston. "And it is a simple system. It has a laser, four acousto-optic deflectors, a light valve, a crystal, a charged-coupled-device detector array, and a few lenses. That's it. I've just given the entire parts catalog for a system."

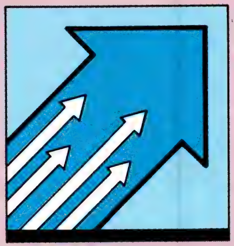
Over a three-year program, MCC officials plan to produce a series of Bobcat II prototypes that could push capacity to the 200-Mbyte to 1-gigabyte range, with costs per Mbyte in the $2 to $6 range. That compares with $15 to $25 per Mbyte for DRAM storage and 50 cents to $2 for optical disk storage.

"The real competition I see is from DRAMs. If this is successful, [PVHS technology] will be much faster than disks and will fill an emerging niche. DRAMs could give those speeds and better. So now the question is whether you can get enough density to be cost-competitive with the future DRAMs," says Pinkston. But even if PVHS can't be made cost competitive, "there are applications where you want to put memory into the nose cone of a missle or in a satellite, but you don't want DRAMs in that radiation environment." *–J. Robert Lineback*

MCC AIMS FOR AMBITIOUS OPTICS PROGRAM

If it can get sufficient backing from sponsors, Microelectronics and Computer Technology Corp. will focus on putting the power of light to work as the bottleneck breaker in computer systems. Nearly 20 MCC shareholders, government agencies, and potential new consortium members were briefed recently on early research that was performed under an exploratory Optics Program initiative.

The proposed program in areas of optical technology for computing (or photonics) represents MCC's first attempt to spin off an exploratory initiative effort into a shareholder-sponsored multiple-exploration program. In a prospectus on the program being circulated to interested parties, MCC describes the effort as relatively small at its start. A proposed fee structure, based on a minimum of required participants, shows the cost of membership to be $75,000 per year for MCC shareholders and associates. Government agencies may join for a share of the cost, plus a 10% fee.



The program will be structured like other original MCC programs, with a nucleus research effort working on core technology. Exploration projects would be launched as shareholder interest or research opportunities dictate. A shareholder's annual fee would cover one exploration project. Additional projects would cost $55,000 a year. Associate members would be required to pay $25,000 up front to cover funds already spent on the work.

"We are looking at how to use optics in computers. It is not optical computing, but it is aimed at using optics to get around problems we have found in exisiting computers," says Steve Redfield, the member of the technical staff who has headed the optics initiative since its start. "We think optics, with its physics, can do something differently and get around some of the problems of electronics."

The MCC Optics Program will start with four targeted exploration projects. One exploration, called Octopus, will be exclusively a government project aimed at identifying and using optical technology in existing or near-future parallel computing systems. The Defense Advanced Research Projects Agency has agreed to fund the effort for one year at $655,188 and has tentatively agreed to back another eighteen months.

Bobcat II is meant to create a second-generation volume-holographic storage system from the photorefractive technology developed while the optics program was an exploratory initiative. The effort will be to produce an optical storage system that delivers up to three orders of magnitude improvement over the access-time delays of disk storage systems. MCC expects to have this effort 75% co-funded for a three-year period by one or more government agencies. The initial goal is to have at least two nongovernment shareholder companies involved.

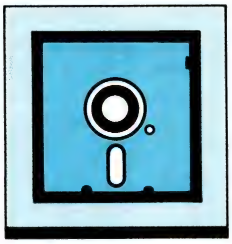
CROSSBAR. The exploration project called Ox is aimed at producing a large optical crossbar switch based on a beam-steering technique that uses a collision-detection protocol for distributed arbitration. The target is to support data rates of up to 10 GHz and a crossbar with 1,000 nodes. Already, a 2-by-2 crossbar switch running at 1.3 GHz has been built. A 32-by-32 switch will be ready next year. MCC aims to start with eight companies in the effort.

A optical weighted-logic neural-network effort is being called Owl. It's aimed at developing a large net using photorefractive material. The research will involve learning algorithms suitable for optics. Three years of work is initially planned for two phases, and a third phase will be aimed at a 100,000-neuron all-optical neural net. Four firms are needed to start the project. *–J.R.L.*

EMBEDDED-SYSTEM BUILDERS GET MUCH-NEEDED CASE TOOLS

New tools go after software's biggest headache: making real-time systems work

by Jonah McLeod



The end of 1988 is seeing strong and very welcome progress in computer-aided software engineering tools for developing embedded systems. The near-desperate need for such tools has only been highlighted in the last year or so by the fast-rising level of automation in computer-aided engineering for hardware—chips, boards, and systems. Strides in hardware CAE have left the state of the CASE market looking archaic, and nowhere is that shortfall felt so acutely as in projects that involve the development of complex software for real-time embedded systems, projects where stretched-out project deadlines and frustrating cost overruns are the norm.

New embedded-system CASE tools, however, are beginning to provide software developers with productivity gains like those being enjoyed by hardware designers. As more and more useful tools appear, this segment of the CASE market is taking off.

Embedded systems are computers dedicated to a specific function, like disk-drive or laser-printer control in a larger computer system; or navigation, electronic warfare, or other control functions in an avionics package. Their special problems relate to the fact that they must be precisely coordinated with other parts of the system and must have fast, predictable responses to real-time interrupts coming from elsewhere in the system and the outside world.

GRAPHIC SPECS. Many of these systems, particularly in the military arena, are so complex that it is a major challenge simply to define clearly how they operate at the outset of a project. The software community is addressing these problems with what are called front-end CASE tools. In the beginning phases of a software project, they let systems engineers build "executable specifications"—graphically represented sets of system specifications that can be simulated directly to see how the system will work when finished [*Electronics*, Nov. 1988, p. 37].

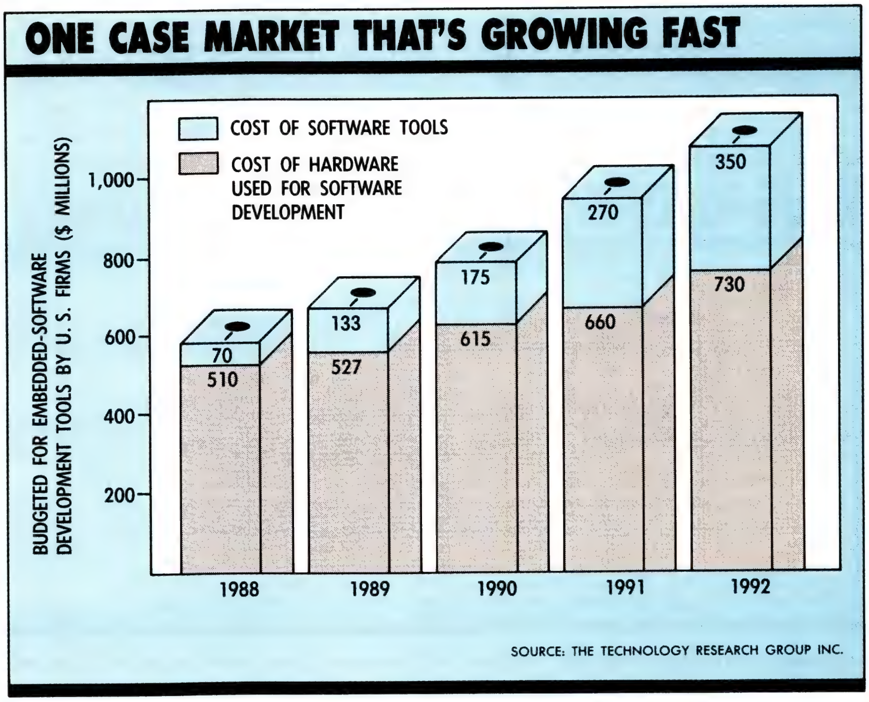
In the back end of the development process the actual coding is done, followed by software debugging, testing, installation, and maintenance. New back-end CASE tools move design data generated by front-end tools smoothly into the coding phase. New code generators automatically produce executable programs. New simulators, like those from Hewlett-Packard Co., Palo Alto, Calif., allow programmers to debug their software at their work stations, or within their minicomputer or mainframe environment, to save time debugging on the actual target hardware, which is not always available when the first software modules start arriving (see p. 98). Finally, new test-generation tools help produce tests and measure the amount of test coverage of software being produced.

The 1988 market for CASE tools, lumping those for MIS and commercial applications together with embedded systems, will be worth $5.33 billion, according to the Technology Research Group, a market research firm that follows CAE and CASE markets. That figure, which is a compilation based on the budgets for CASE-tool spending at government and commecial customers, includes the hardware that the tools run on, and that hardware still represents the lion's share of the budget. By 1992, the total will double to $10.05 billion, says Torry Hinder, director of research at the Boston company.

Of the total, sales of tools into the MIS segment are the largest. The Technology Research Group projects that they will account for nearly $4 billion of 1988 revenue and $7.5 billion in 1992. Sales in the commercial-software segment is second in size, with $760 million in revenue expected in 1988 and $1.48 billion in 1992. Sales of CASE tools for the embedded computer marketplace are currently the smallest of the three segments, but are growing at the fastest rate.

In 1988, sales of tools for embedded-computer software development will be worth $580 million and will grow between 13% and 20% per year to $1.08 billion in 1992. But spending on the software tools alone will grow at a much steeper rate. Of the 1988 total, only $70 million will be spent on software tools for embedded-system CASE. In 1989, Hinder says spending on software tools will grow 90% to $133 million; by 1992 spending will hit $350 million.

Some of the most exciting CASE tools driving this growth will be for front-end



ONE CASE MARKET THAT'S GROWING FAST

SOURCE: THE TECHNOLOGY RESEARCH GROUP INC.

of Beaverton, Ore., has a transformation capability which automates part of this process. "It uses the data contained in the functional specification to produce an optimized structure chart," says Patrick Glidden, technical marketing engineer at Mentor Graphics.

Three metrics are used by the tool to produce its suggested structure chart: overall complexity of the design (based on the number of levels, number of items per level, number of call statements, and other factors), how close the implementation is to a true tree structure, and level impurity (how clean the design is within a given level). The software works from the assumption that a tree structure is a good design, says Glidden.

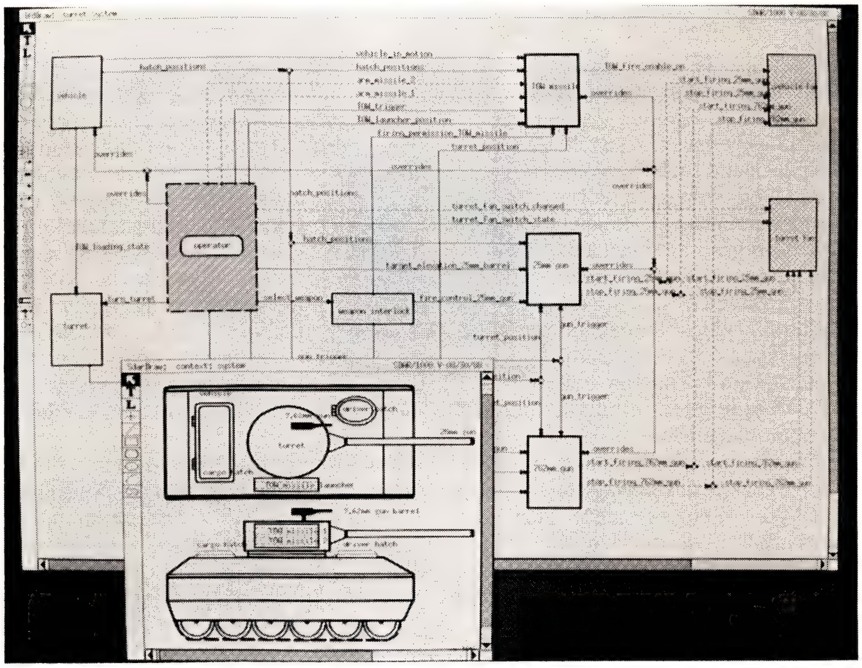
The tool looks at the designs resulting from the automatic transformation and shows the systems engineer each possible design in terms of the three metrics. Thus it allows the systems engineer to pick the design that best fits his needs. The other strength of the Mentor tool is its ability to reengineer a structure chart backwards, starting from object code. Mentor has just announced that the CASE tool offering (acquired in their purchase of Tektronix Inc.'s CAE division) will be running on a new Apollo Casestation announced this month.

When serious coding begins, back-end tools are called upon. Compilers, debuggers, and simulators are key elements. And as software modules get written, any changes that are required in the specification must be back-annotated to the original structure chart by these tools. Others are dedicated to documenting and maintaining the completed software modules.

New back-end CASE tools are taking advantage of the data produced in the front end of the process. After the executable specification is debugged, it goes to designers who create a structure chart, which is a hierarchy of programs needed to implement the software system. At the bottom of the structure are the program modules to be written. These structure charts are then used by the software developers who write the actual programs.

CODE GENERATION. One recent addition to the i-Logix Statemate tool is a product called Prototyper. According to Rolph, Prototyper generates prototype Ada code of a process so that the systems engineer can execute real software functions in a simulated or prototype hardware environment.

But a more practical tool for the programmer generating code is one that performs the housekeeping tasks involved in writing a program. Ted Gary, director of marketing at Microcase Inc. in Beaverton, Ore., explains that in the structure chart are two elements useful for the software developer, a data dictionary and a module specification. The former is a list of all the local and global variables used throughout the project. The module specification describes in text or high-level programming language what the module must do. Microcase's Source Frame Builder, introduced in September and now being shipped, automatically creates the source files needed to produce the program for each program module in the structure chart.



Complex systems can be viewed graphically at high levels of abstraction with Athena's Foresight. Specifications developed this way are easy to understand—which reduces errors.

In actually writing the final program, one problem confronting the software developer is how to debug his software without target hardware. Gary says that target hardware is expensive and rarely available in fully functional form until late in the hardware design cycle. One interim solution to the problem is to do system simulation on a work station rather than debugging on the target system.

One of the more recent simulator offerings is the Ax/DB tool in the AxCASE tool set from Hewlett-Packard's Logic System Division in Colorado Springs, Colo. It lets software developers write programs for and simulate the execution of the Intel 8086 and Motorola 68000 families of microprocessors on the HP9000 Series 300 work station.

Microcase has had a similar offering, the X-Ray Simulator/Debugger, available for a year now. With it, software developers write in C, Fortran, Pascal, or the assembly language of the target microprocessor on any popular software development platform.

A year ago, simulators were not considered useful, Gary says. "The argument was that simulators are slow—which they are—or that debugging software outside of the target hardware isn't useful," he says. "Now, there is a growing realization that a software developer can fix logical errors in a simulator before going into the target hardware." The benefit of simulation is that when software is integrated in the target system, any remaining errors are likely to be due to hardware-software integration rather than pure software faults.

The one other nagging problem facing the software developer is testing the module to see that it actually performs the function for which it was intended, according to George Symons, of Sun Microsystems Inc. in Mountain View, Calif. He says that tools are required to examine the finished program, provide information about it, and detail what conditions must be met to test all the options of the program. It should also have coverage tools to ensure that the tests have actually checked all parts of the program. Companies producing such products include McCabe & Associates Inc. in Columbia, Md., Software Research Inc. of San Francisco, and Programming Environments Inc. in Tinton Falls, N. J.

The product from Programming Environments, called T, is typical of the capability offered by the group. It works from requirement specifications generated in the front end of the design process. "T will design, document, generate and trace the test case by choosing input values to exercise software under test," says Robert Poston, president of the company. "The tool achieves 0.072 failures per 1,000 lines of code. By contrast, NASA gets 0.1 to 0.7 failures per 1,000 lines of code." In addition, Poston says the software developer can get an 8-to-1 reduction in time required to generate tests. ☐

C&C Computers and Communications

Display of mastery.

Top-flight color CRTs for sophisticated display subsystems.

Many companies make color display tubes. As a technology leader, NEC concentrates on high-performance, high-quality, high-resolution CRTs.

NEC specializes in display tubes for the most challenging applications—CAD/CAM, medical imaging, and mainframes. Our displays define the cutting edge of CRT technology. That's why they offer the razor sharp resolution your system demands.

NEC is the originator of the in-line gun system. We give you a broad line and advanced options including:

☐ Diagonal sizes from 6 to 21 inches
☐ Phosphor pitches from 0.39 to 0.21mm
☐ Anti-static coating
☐ Saddle-saddle deflection yokes
☐ Dynamic quadrupole focus guns
☐ Portrait-mode displays
☐ Flicker-free phosphors

The display is the crucial interface that allows your system to reach out and grab the user's eye. To display your commitment to quality, go with the acknowledged leader in CRT technology — NEC.

For fast answers, call us at:

USA	**NEC Electronics Inc. Tel: 1-800-632-3531. TWX: 910-379-6985.**
Europe	**NEC Electronics (Germany) GmbH Tel: 0211-650302. Telex: 8589960.**
	NEC Electronics (France) S.A. Tel: 1-3946-9617. Telex: 699499.
	NEC Electronics Italiana S.R.L. Tel: 02-6709108. Telex: 315355.
	NEC Electronics (UK) Limited Tel: 0908-691133. Telex: 826791.
Asia	**NEC Corporation Tel: 03-454-1111. Telex: 22686.**

Circle 99

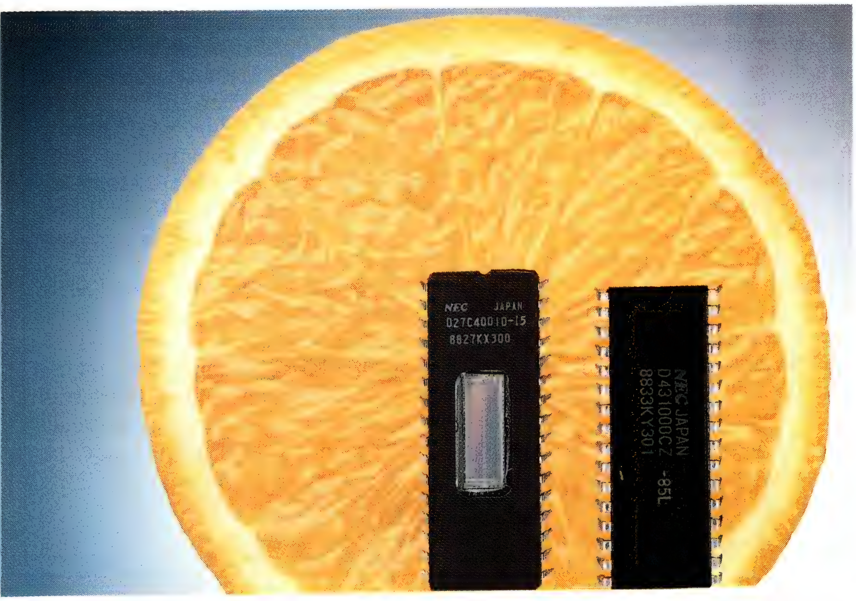
NEC

class of

NEC expands your design horizons with a new class of high density memories – 4M EPROMs and 1M SRAMs. These chips not only give you greater capacity, they also offer high speed and low power consumption.

4-Megabit UV EPROMs

NEC leads the industry again with the introduction of 4M EPROMs. Providing unprecedented flexibility for storage of large-scale programs and fixed data, these devices help you achieve higher design goals.



The μPD27C4001DZ is fabricated with a 1.0μm CMOS process. It comes in a 512K x 8 organization, and offers many advanced features, including –

☐ Fast access: 150/170/200ns
☐ Fast programming: less than 60 seconds for all 4 megabits
☐ Low power consumption: 30mA (max) active; 100μA (max) standby
☐ 32-pin DIP with JEDEC standard pinout

1-Megabit SRAMs

Our new SRAMs give you 1-megabit density combined with 85ns access speed and low power consumption: 70mA (max) active, 100μA (max) standby. For battery back-up needs, we offer the L-version which requires only 50μA (max) for data retention. The μPD431000 family features:

☐ 128K x 8 organization
☐ 3 speeds: 85/100/120ns
☐ 32-pin 600 mil plastic DIP; or 525 mil SOP

To find out how megabit memories can multiply your design possibilities, call NEC today.

UK Tel:0908-691133. Telex:826791.
Hong Kong Tel:3-755-9008. Telex:54561.
Taiwan Tel:02-522-4192. Telex:22372.
Singapore Tel:4819881. Telex:39726.
Australia Tel:03-267-6355. Telex:38343.

Circle 101

NEC

extent to which AT&T cut costs. "When AT&T was forced to compete, it cut thousands of people and that process is probably not yet ended," says Stern. "Increased cost-cutting is a stated policy," and the implication is that personnel cuts will continue to be a large component.

While AT&T's corporate strategy after divestiture has taken a straight-line path, the RHCs and their subsidiaries and the local Bell operating companies (BOCs) have been plagued by eroding financial results. This has spurred them to move into nonregulated businesses, but not without a regulatory hassle.

The waiver process is a means of determining if the line of business being suggested violates the three restrictions that still exist from the original decree: RHCs cannot manufacture equipment and they can't provide information services or long-distance service. All three restrictions are under attack by the RHCs and their attorneys.

Tracking the RHCs' line-of-business waiver requests shows that there are favorites among unregulated business types. For example, each of the seven has requested—and received—waivers to become publishers. Just as popular are foreign business ventures, cellular-phone monitoring and consulting services, and software development. Only Ameritech has stayed out of the real estate business, and only Bell Atlantic and U. S. West have refrained from foreign cellular-phone ventures.

The lure of profits unregulated by utility commissions—added to a bleak outlook for the regulated phone service business—makes a powerful argument for diversification. In essence, the RHCs and BOCs want a future that makes them something more than a conduit for the information surging through their phone lines. Stern says, "If you look at them from a financial view, their fast growth after the breakup has slowed. Now, they are delivering returns more typical of a utility. They have a utility valuation but they're sitting on a high-technology company's corporate assets."

A financial analysis of the RHCs since divestiture released recently by the Big Eight accounting firm of Touche Ross Partners, Washington, D. C. confirms Stern's view. Two factors have contributed to the slump, says Joe Kraemer, Touche Ross's industry national director for telecommunications. In the months before and after divestiture, local phone companies received an unusually large number of rate increases, which made for healthy earnings early on. "It was as if the lid came off a repressed demand for about 18 months," he says. Over the past few years, however, most state utility regulators have adopted a no-rate-increase attitude. Forget about increased margins, they say. The RHCs think that regulators may not allow them to make even the smallest profit at all on basic services, says Kraemer.

State regulators have taken a no-rate-increase attitude in the past few years

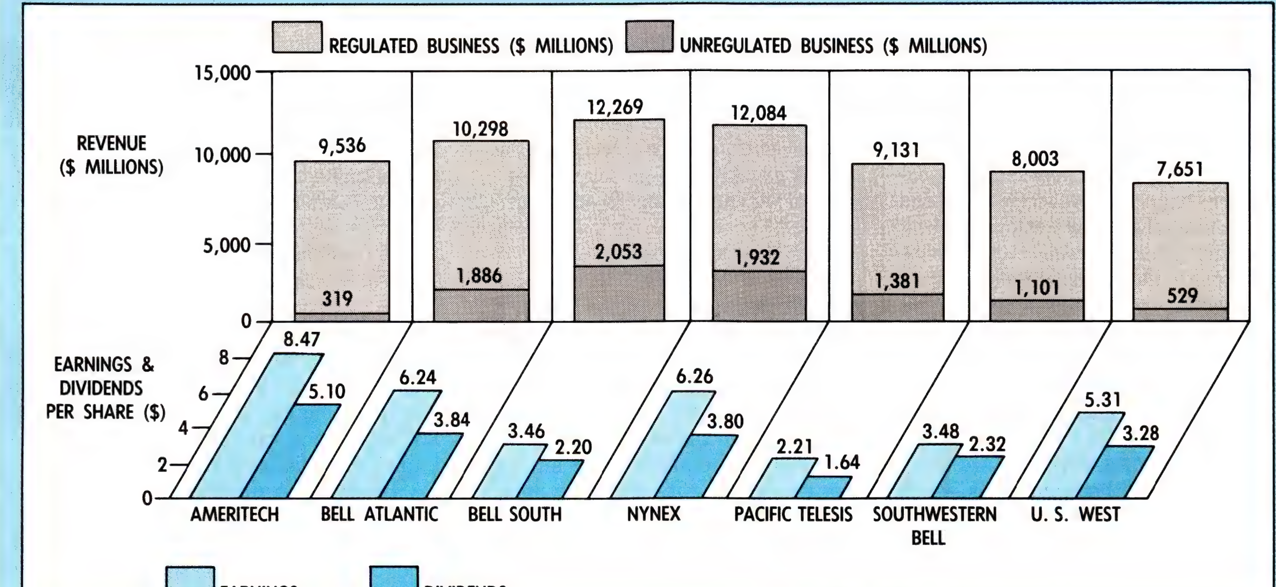
The RHCs depend heavily on regulated phone business for revenues. In 1987, for example, regulated business accounted for $59 billion and unregulated businesses $9 billion. For the most part, the RHCs have not done particularly well in nonregulated ventures unrelated to their core business, says Touche Ross's Kraemer. Retail computer stores, for example, have been purchased and then sold off, but it is difficult to be definitive about how the RHCs are doing in businesses where they have competition because they are careful not to report separately the revenues and profits or losses from specific lines of business, he says.

The RHCs are not pemitted to manufacture equipment, but they have gone hot and heavy into selling network and customer-premises equipment. Starting from zero market share, their impressive results brought squealing protest from competitors. Through subsidiaries organized to market equipment, the RHCs captured 17% of the market within 18 months of divestiture and an additional 8% in the next 12 months, says Edward Spievack, president of the North American Telecommunications Association. The RHCs managed to do this, says Speivack, by "cutting the bottom out of the price."

SUBSIDIARY LOSSES. Until 1987, the operating companies were required to set up separate subsidiaries for their nonregulated businesses, and the North American Telecommunications Association, which represents BOC competitors, claims this requirement of separate accounting for each entity showed that most BOCs were operating at a loss in their nonregulated businesses.

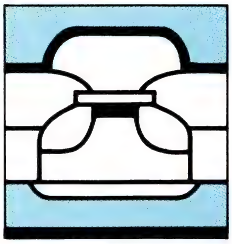
Nevertheless, the market for custom-

THE RHCs AT A GLANCE



SOURCE: NORTH AMERICAN TELECOMMUNICATIONS ASSOCIATION

AT IEDM: GET READY FOR THE ULSI DEBATE



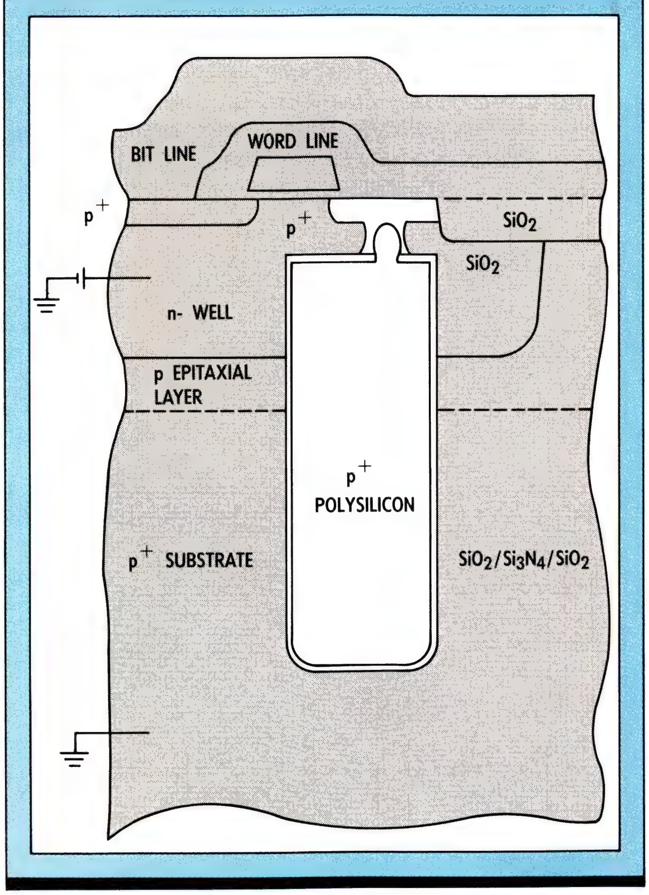
Just as the industry is getting comfortable with the chip densities it can achieve at very large-scale integration, design physicists and process engineers are about to up the ante. Judging by what they will be reporting at this year's International Electron Devices Meeting, the move is on from VLSI, with design rules of 1.25 to 0.75 μm, to ultralarge-scale integration, using rules of 0.25 μm and below.

The researchers are scheduled to speak at the annual event to be held on Dec. 11-14 in San Francisco and will describe CMOS transistor structures and cell designs based on design rules as low as 0.5 μm. Densities like that mean that today's leading edge—dynamic random-access memories of 1, 4, and 16 Mbits; 1-Mbit static RAMs and erasable programmable read-only memories; and logic circuits of 250,000 to 750,000 gates—is about to become the mainstream. The new frontier will be devices with 100 million transistors on a single die.

The first comers will be memories—very large memories. Researchers are reporting the advent of cell designs that will allow the construction of 64-Mbit DRAMs, 4-Mbit SRAMs and EPROMs, 1-Mbit electrically erasable PROMs, and even nonvolatile RAMs with densities of up to 256 Kbits.

How to reach these densities is the subject of ongoing debate, which is expected to resurface at IEDM. The most direct approach is to modify existing transistor and cell structures, but exactly what these modifications should be is open to question. Researchers from the U. S. and Japan, for example, are generally taking different approaches. As they do so, they must learn how to deal with formidable obstacles caused by second-order effects. Among them are hot electron carriers, interconnection resistance, subthreshold turnoff, and transconductance degradation. Some other problems include sensitivity to temperature, electromigration, threshold shifts, and dielectric wear-out.

CUTTING DRAM SIZE IN HALF



IBM's trenched approach produces a DRAM cell structure that the company's researchers say is about half the size of current designs.

Another debate surfacing at IEDM grows out of the continuing advances being made in lithographic tools and techniques, which are vital in achieving greater densities. Those advances are raising the issue of whether the industry should stick with conventional optical lithography or push on to X-ray lithography.

The question of how to modify transistor and cell structure is perhaps most evident in DRAMs. To reach the 64-Mbit level, it will be necessary to shrink cells to under 1.5 μm²—a reduction of almost an order of magnitude below what is now possible. At the same time, designs will have to maintain or improve the storage capacitor's ability to retain charge long enough to be refreshed. At IEDM, IBM Corp. summarized the different modifications that could be used and cast its vote for a trenched approach. Coming from another direction were a number of Japanese designers who favored a stacked, three-dimensional cell solution.

Scientists at IBM's Research Division in Yorktown Heights, N. Y., and its General Technology Division in Essex Junction, Vt., are using a new technique based on epitaxial overgrowth technology. At IEDM, they described a self-aligned buried trench cell that measures 7.8 μm², and uses 0.85-μm design rules. At this size, the cell is a bit more than half as large as what is possible in current 4-Mbit and 16-Mbit designs.

The cell has a bulk horizontal transistor fabricated in an epitaxial layer over a buried trench capacitor with a via connection between the trench and the access transistor. A horizontal access transistor accesses the trench capacitor, which uses a heavily doped substrate as a grounded plate. The result, say the researchers, is a cell area defined by the geometry of the access transistor alone. With improved lithography, they say, the cell area can be reduced to less than 1.5 μm to achieve 64 Mbits.

Taking the stacked-capacitor approach is Fujitsu Ltd. Its researchers reported on a new design in which the bit lines are formed below, rather than over, the cell plate, and in which the storage node is formed by two polysilicon layers, surrounded by a capacitor dielectric film. Using one layer, the researchers say, increases capacitance in the cell by 70% over current designs; two layers raises capacitance threefold. Using 0.5-μm design rules, the researchers report achieving a 16-Mbit design with a cell size of only 4.0 μm². With scaling to below half a micron, they believe a cell measuring 1 μm² or smaller is possible, and is more than enough for a 64-Mbit design.

An alternative stacked-capacitor approach comes from Hitachi Ltd.'s Central Research Laboratory in Tokyo. Scientists there have developed a diagonal active stacked-capacitor cell for use in 16-Mbit DRAMs that they think also has potential at the 64-Mbit level.

One problem with the conventional stacked-capacitor cell, say the Hitachi researchers, is that the bit line must be connected to the memory-cell transistor's drain through the window of the storage cell's plate electrode. This results in a significant decrease in capacitance. In their new design, they have placed the storage capacitor on the bit line, by setting the active area diagonal to it and to

A19100-B-Z070-V1-X-7600

bances and large propagation delays.

Unlike a DRAM, a static RAM must hold data forever, rather than for just a few milliseconds. As a result, the leakage associated with silicon defects at densities higher than 1 Mbit can be disastrous. Also, as densities increase, subthreshold leakage increases. And scaling down the resistor loads used in SRAM cells without affecting performance can create problems, too.

To deal with all of these obstacles, or at least to design around them, researchers from Hitachi and Toshiba have each developed radically new SRAM cell designs.

Hitachi scientists solved the problem of load resistors with a bold stroke: they got rid of them. Polysilicon p-channel MOS transistors are used in their place, and cross-coupled capacitors are incorporated to increase the cell charge in compensation for the smaller cell size.

In a polysilicon p-MOS load cell, an asymmetric p-MOS transistor is fabricated on the driver n-MOS transistor with the p-MOS gate electrode under the channel polysilicon. This forms a set of cross capacitors atop the four-transistor SRAM cell. Using 0.5-μm design rules, Hitachi has built a 4-Kbit SRAM array in which the cell area was reduced to 25.38 μm^2, about half the cell area of a 1-Mbit SRAM using similar design rules, and about one quarter the area of those with 1.0-μm design rules.

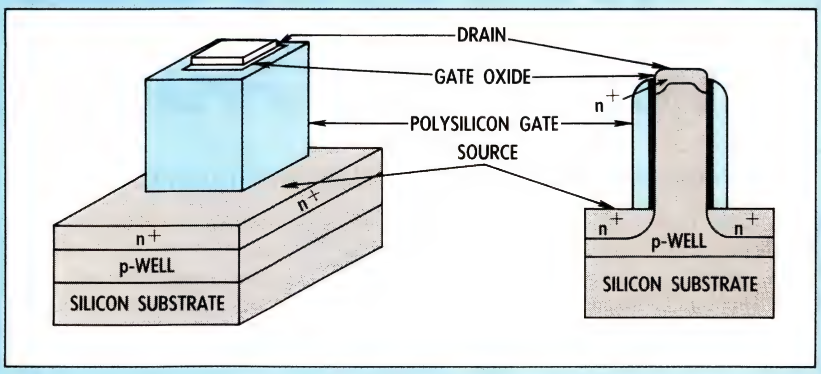
An even more radical approach comes from Toshiba, which unveiled at IEDM a novel biCMOS SRAM based on the reverse base-current effect. Consisting of only one bipolar transistor and one MOS transistor, the cell uses 1.0-μm design rules and measures 8.58 μm^2. That's about 65% smaller than the DRAM cells used in current 1-Mbit designs. The Toshiba researchers claim that the cell operates by a mechanism that is entirely different from the mechanism of either traditional DRAMs or SRAMs.

NEW WAY. Electrons are injected from the emitter of the bipolar transistor, generating electron-hole pairs by means of impact ionization at the p-n junction between the base and emitter. These generated holes drift to the base region—but do not flow to the emitter—through a fixed-base emitter voltage to limit hole current. Therefore, the excess hole current is forced to flow to the base terminal. Toshiba researchers say that SRAM designs as dense as 16 Mbits or beyond should be possible with the technique.

In logic circuits, meanwhile, the IEDM showcases a wide range of proposed transistor structures aimed at allowing the construction of devices under 0.5 μm.

Among them is a dual-poly n+ and p+ gate structure, described by researchers from IBM's Watson Research Center, that is aimed at 0.25-μm CMOS designs. The structure avoids the buried-channel operation of p-channel field-effect transfers, resulting in a performance of about 350 ps per delay in a loaded ring oscillator—some 1.5 to 2 times the performance of 0.5-μm-based designs using conventional techniques.

LOGIC CIRCUITS REACH ULSI DIMENSIONS



A Toshiba surrounding-gate transistor for logic circuits reduces the area occupied by a gate transistor by as much as 50%.

One of the most aggressive logic-circuit proposals is from researchers at NEC Corp. in Kanagawa, Japan, who suggest a shift from the traditional silicon gate to a tungsten-gate structure. The one problem that has prevented the use of tungsten at submicron geometries has been short-channel effects and threshold-voltage sensitivity.

In the wings are 64-Mbit DRAMs, 4-Mbit SRAMs, and 1-Mbit EEPROMs

To deal with both of these hang-ups, the NEC scientists use selective epitaxial growth techniques to grow a low-impurity epitaxial channel with a thin gate oxide.

Claiming ULSI densities, researchers at Toshiba's ULSI Research Center in Kawasaki have conceived a surrounding-gate transistor, in which a gate electrode surrounds a silicon island.

With this scheme, the effective channel width is at least four times larger than a comparably sized planar transistor. In addition, the area occupied by a gate transistor can be reduced by as much as 50%. In spite of the pillar structure, the substrate bias current is smaller than that of planar transistors. Also, the field-isolation-free structure suppresses hot-carrier degradation and reduces substrate bias effects.

Also from Toshiba comes a double-concave, lightly doped, drain structure in which u-grooves are etched to form concave structures that decrease the electrical field near the drain. This significantly reduces short-channel effects, without reducing the channel length.

All of the advances in device density are related to advances in lithographic techniques. But as the era of ULSI approaches, the decision about which lithography technology to use becomes more critical. At some point fairly soon, semiconductor houses are going to have to decide whether conventional optical lithography can be refined to reach the ULSI range, or should give way to X-ray-based lithography.

Both sides had backers at IEDM. Among the proponents of optical technology were a number of researchers who think techniques using an excimer laser are the best way for optical lithography to reach patterns smaller than 0.35 μm, says Louis Parrillo, IEDM's technical program vice chairman. The laser's chief disadvantage is that present techniques require a single resist layer that degrades because of strong photo-absorption. To overcome this limitation, researchers from Matsushita's Semiconductor Research Center report that they have developed new photo-bleachable transparent resists and process technology for use with excimer lasers. This has allowed them to obtain high-aspect-ratio resist patterns with the large focus latitude necessary for larger die and wafer sizes, the researchers say.

The X-ray's backers include Alan D. Wilson, senior researcher at IBM's Watson Research Center. Using X-ray technology, he and his coworkers have achieved resolutions as small as 0.1 μm and fabricated not only 0.5-μm n-channel transistor structures but simple circuits as well. The chief advantage of X-ray lithography is that it has a large depth of focus, relative to optical techniques, and does not employ any optical elements between the mask and the wafer to limit field size. Both, says Wilson, are important as wafer and chip sizes continue to increase. *–Bernard C. Cole*

Transputers are often thought of as being in a class by themselves, but it is not unreasonable to group them with reduced-instruction-set computers. RISC-like features include a relatively small number of instructions; an instruction set designed for high-level-language programming; the fact that most frequently executed instructions take just one machine cycle to execute; and simple instruction and decode logic that allows Inmos to achieve high clock rates.

The continuous increases in clock speed that Inmos has achieved is one important way the company is meeting one of its fundamental goals: staying abreast in performance with any single-chip processor. "If any single processor has X level of performance and the transputer matches it, then the multiprocessor systems built with the transputer will be light-years ahead of the single microprocessor," says Ray Oliver, director of worldwide sales and marketing of Inmos.

It has taken some time for computer architects around the industry to figure out just what they could do with transputers, and more time after that to execute their designs. But now Inmos can cite a list of applications that proves that the transputer is not a niche product, as some industry observers thought it would be. The company says the product's worldwide design base is now about 1,200 designs and growing. Not all of these applications are far enough along to be announced; about 250 of them are in production and several others have been announced but are not yet shipping. There are some 3,000 other projects evaluating the transputer, Inmos says.

The first transputer products were mostly accelerator boards to be added to other computers to boost their performance, and this is still the category with the greatest number of released products. These boards target the widest possible markets, like IBM personal computers and compatibles, Apple Inc.'s Macintosh II, and work stations from companies such as Digital Equipment Corp., Apollo, and Sun Microsystems.

ACCELERATOR CARDS. At least 20 companies have announced add-in boards with multiple transputers, and most are already delivering them. For IBM PCs and compatibles, products are available from Computer Systems Architects, hema Electronik, Micropar, Microway, Nth Graphics, Quintek, Sang Computer Systems, Significat, and TU-Berlin. Cards for the Apple Macintosh are made by Topologix Inc. and Levco Corp., both of San Diego; Megabyte Computer Inc. of Webster, Texas, sells a card for the Atari ST; and Commodore Computer GmbH makes one for its high-end PCs in West Germany.

In the work-station arena, two companies make boards for Sun products—Niche Data Systems Inc. of West Newton, Mass., and Gems of Cambridge Ltd., Cambridge, UK. Gems of Cambridge also makes add-in accelerators for Apollo Computer systems, as does Signficat Inc. of Hudson, Mass. Caplin Cybernetics Corp., London, makes them for DEC MicroVAX systems.

A second type of application is the use of one or multiple transputers as the CPU in embedded systems, such as laser-printer controllers or the image-processing system from Kodak Corp., Rochester, N. Y. IBM Japan has built a PC-AT-based image-recognition system for use in its Japanese production plants for inspection and control, although it has announced no plans to market it as a product. An image processor from Gems of Cambridge is designed to process satellite images of the earth to identify types of land usage.

Inmos expects to ship 100,000 transputers in 1988 and triple that in 1989

The transputer boards developed by Kodak's Digital Technology Center in Rochester are for an interactive image-computing work station. The parallel-processor board set is based on multiple T800 transputers. The processing power provided by multiple T800s is needed for advanced image processing, because of the quantity of information represented by a typical digital image. With massive amounts of image information to process, total processing time is likely to be minutes or hours for a single image when a single microprocessor or minicomputer is used. Kodak ran a number of benchmarks demonstrating how a multitransputer system can significantly cut processing time (see chart).

The current boards are double-height Eurocard size—9.2 by 11 in.—for the VMEbus. One board has a total of 16 transsputers and 1 Mbyte of additional memory beyond the 4 Kbytes on each processor chip. Another board has only four processors, but carries 4 Mbytes of memory for each, for a total of 16 Mbytes.

Kodak has built a number of image-processing systems using these boards for internal use, says Billy E. Cates, manager of Kodak's Digital Technology Center. The company's Federal Systems Division demonstrated a complete image-computing environment in October. It is a work station with a 240-million-instructions/s image-processing accelerator, a 1.4-million-pixel charge-coupled-device digitizer, an optical-disk drive, and laser printers.

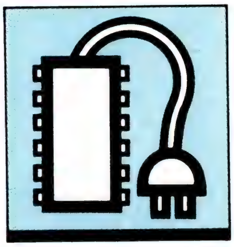
The third major type of transputer application is stand-alone parallel computers with transputers as CPUs. Like embedded-transputer systems, many of these are graphics or imaging specialists. Among them are the Computing Surface from Meiko Ltd. in Bristol, UK [*Electronics*, Nov. 27, 1986, p. 56], the Target from Parsytec GmbH [*Electronics*, March 3, 1988, p. 72], a graphics computer from Impuls Computer Systems of Vienna, the Parallax supercomputer from Sension of Northwich, UK, and a work station from Sheldonberry Electronic in Wurzburg, West Germany.

One recently introduced and technically advanced example is the expandable computer system from Cogent Research Inc. of Beaverton, Ore. It calls its XTM a modular parallel-processing supercomputer, and claims that it packs supercomputer power into a PC-size package. The system can be configured with from 2 to

A software environment called Linda developed at Yale University is used in Cogent Research Inc.'s desktop XTM parallel system, which can have from 2 to 400 transputers.

MOS FET EXPANDS ENVELOPE FOR BOTH POWER AND SPEED

Advanced Power Technology has taken an approach that is radically different from that of other power FET makers



Advanced Power Technology Inc. is taking MOS field-effect transistors into power-handling territory where no company has gone before. It has come up with a fast 1,000-V device capable of handling 20.5 A, double the current-handling capability of conventional power MOS FETs. It's not just powerful; it's fast, too. It can be used in applications where it switches at rates nearing 1 MHz, compared to rates of about 40 KHz for bipolar devices that have equivalent power-handling capability.

The new device is built with an approach radically different from that used in current power MOS FETs. Instead of building up a big power device from a large number of small closed-source devices fabricated on one die and connected, the APT1000FN is a single transistor with interdigitated metalization for the gate and source. Reverse recovery time is only 390 ns; and on-resistance, that crucial figure for power-handling capability, is only 0.5 Ω. The design approach taken by the Bend, Ore., company also allows it to simplify the fabrication process. There is only one critical alignment step instead of four.

Key to the power-handling capability of the APT1000 is the departure in design strategy, says vice president of engineering Dah Wen Tsang. The conventional way uses multiple closed-source MOS FET cells connected in parallel or in series on small die using 2-μm design rules. APT's approach is to build single, large power MOS FETs on a large die with a continuous open-cell design, interdigitated metal source, and gate structures. That reduces input capacitance per unit area and results in superior switching characteristics, he says.

SAVINGS. The power-handling capability of the APT1000 sharply reduces the number of MOS FETs used in a design, says Terry Bowman, director of marketing. This opens the way to smaller, less costly, and more reliable circuits without sacrificing speed.

The APT1000's power means MOS FETs can now compete with thyristors and power bipolar transistors, without any of the traditional drawbacks of those devices, says Tsang. Thyristors are limited in operation to frequencies below 5 KHz and have relatively poor noise immunity. Also, thyristors are difficult to turn off once fired, requiring the addition of peripheral circuitry that limits the speed of operation.

Bipolar power transistors offer switching speeds as high as 40 KHz, but suffer from secondary breakdown problems and are difficult to use in parallel or in driving inductive loads. The APT1000 simplifies control schemes, reduces drive requirements, and allows operation at rates approaching 1 MHz, Bowman says.

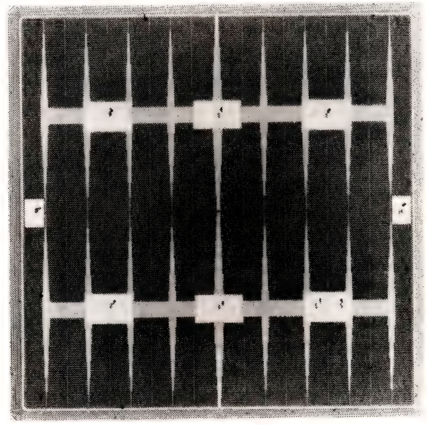
Capacitance problems are what prevent conventional MOS FETs from operating in the frequency ranges where PowerMOS IV devices can, says Tsang. In conventional devices, a trilevel structure is used that incorporates a source metal layer, a polysilicon gate, and an epitaxial layer, all separated by oxide layers. The result is a large input capacitance between the source metal and the gate.

APT's proprietary self-aligned process—which allows implantation, diffusion, and etching to be done with a single mask—eliminates this source-metal overlap and reduces input capacitance, because the source metal does not overlie the gate structures. The additional benefit of this approach, says Tsang, is that where conventional power MOS FETs have up to four critical mask steps out of a total of six, the PowerMOS IV process has only one critical mask out of five, virtually eliminating misalignment problems between mask steps.

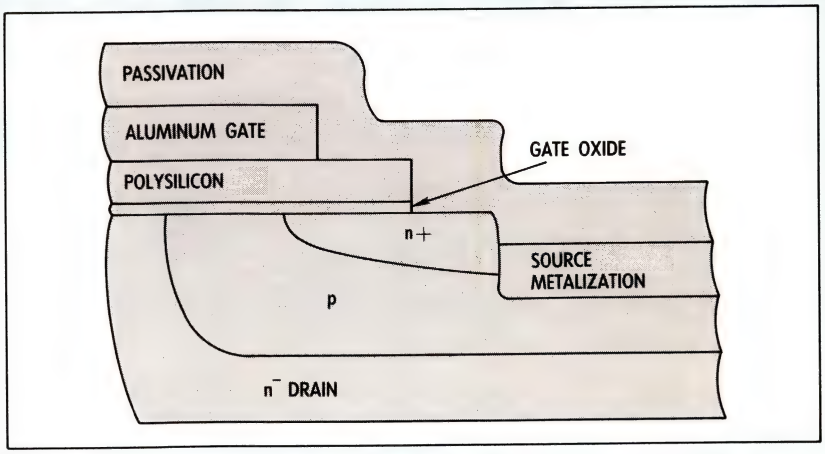
PowerMOS IV also solves a problem with gate resistance. In the conventional approach, polysilicon cell gates are used, resulting in a large resistance—anywhere from 30 to 60 Ω per gate cell—that retards the signal going to the gates. To feed signals to a cell, a metal signal bus drives multiple cells. In a power FET with thousands of cells, there are numerous buses, and the cells nearest each bus turn on and off first. As a device approaches its upper frequency limits, nonuniform current flows throughout the cell array, reducing power-handling capability and increasing switching losses.

By contrast, the APT1000's all-metal open-cell interdigitated gate configuration covers the entire surface of the die. In the single large transistor, each finger of the gate is aluminum and polysilicon, virtually eliminating signal-path delays, and insuring that the device turns off and on evenly and quickly. Turnoff time is cut in half, and power is conserved at high switching speeds.

–Bernard C. Cole

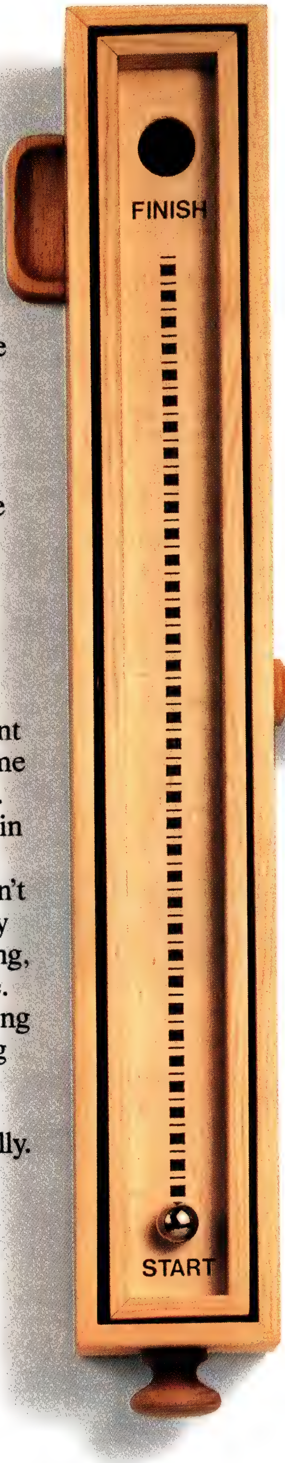


LOW CAPACITANCE FOR HIGH SPEED



Source and the gate metalizations form an interdigitated pattern on the APT1000FN die (top). In conventional power MOS FETs, source metalization overlaps the gate, separated by a thin oxide; this creates speed-robbing capacitance, and is avoided in the APT1000FN (bottom).

The Cadence approach.



How you play the game determines if you win or lose.

And there's plenty at stake. Your design. Your product. Maybe even your company.

Traditional IC design is full of pitfalls and blind alleys. While there are plenty of good tools available, none of them really work well together.

There is a better approach.

Design Framework™ architecture from Cadence. The first integrated design environment to support the entire IC design process. A system that lets you go from start to finish in one smooth, direct path.

Not a "shell," Design Framework architecture is a unified environment where all design tools share the same user interface and design database. So important details never get lost in transit. Or garbled in translation.

But Design Framework tools don't just passively coexist. They actively cooperate. As your design rolls along, you see the impact of every change. In real time. Catching and correcting errors as they're made. Eliminating the need to go back and start over.

The bottom line—you finish designs faster and more economically. Get to market sooner. And put greater distance between you and your competition.

In fact, Design Framework architecture can boost your design productivity five times or more over the traditional approach.

Design Framework architecture also fits easily into your existing design environment. You can even couple tools you developed or bought from other vendors.

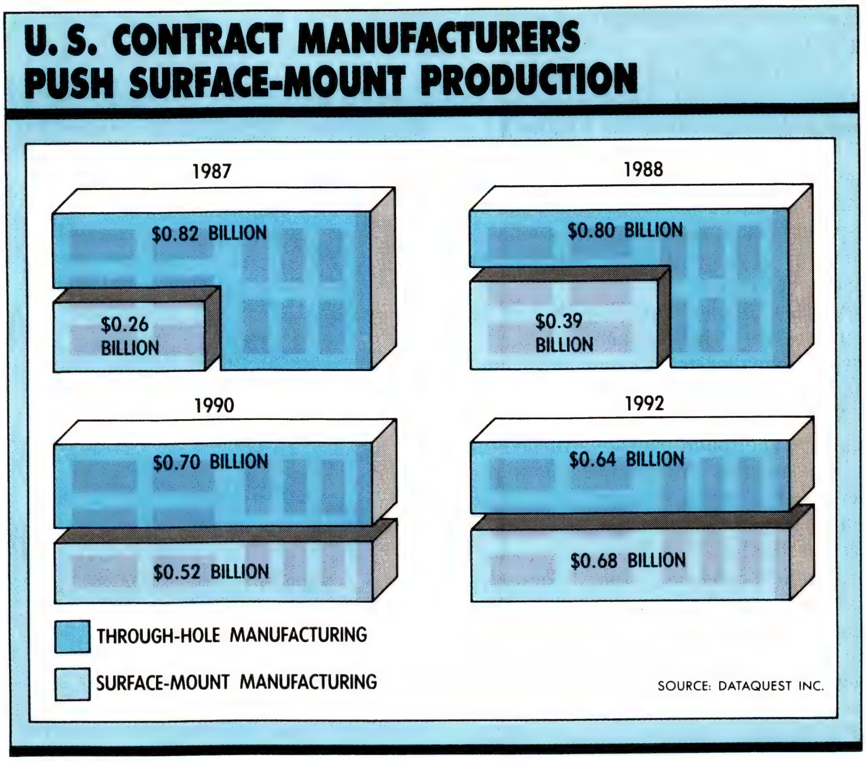
And it's all brought to you by Cadence. The IC design automation software tool leader. We'll be happy to tell you more. Write or call for a copy of our IC Design Game Plan: Cadence Design Systems, Inc., 555 River Oaks Parkway, San Jose, CA 95134, U.S.A. (408) 943-1234 ext. 350. **Or contact one of our international sales offices listed on opposite page.**

Because in today's competitive environment playing by the old rules is a losing game.

CADENCE

Leadership by Design

Circle 115


U. S. CONTRACT MANUFACTURERS PUSH SURFACE-MOUNT PRODUCTION

SOURCE: DATAQUEST INC.

be less complex and thus less expensive on average than those used by American companies. As a result, the North American market accounted for 33.9% of the $7.3 billion total value of surface-mount packages consumed worldwide last year, compared with 45.6% for Asia and 17.3% for Europe, according to Electronic Trend Publications, a Saratoga, Calif., market research firm.

Electronic Trend sees the worldwide surface-mount-component market growing at 28.1% annually, rising to $25.1 billion in 1992. But Japan's share of the total will drop to 37.6% by that time, the firm says. Meanwhile, European use will increase to 24.4%, while North American share will remain roughly constant at 33.6%.

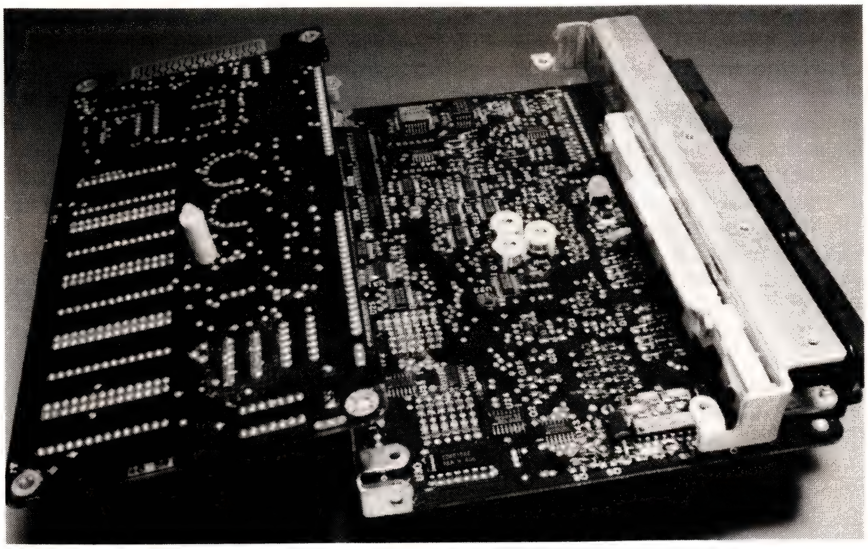
In the U. S., the automotive, computer, and communications industries are currently the largest surface-mount users and are leading the conversion from through-hole, says Electronic Trend. About 75% of all automotive electronics suppliers used some surface-mount technology last year, while about 70% of U. S. computer firms did likewise. About 30% of U. S. communications equipment makers are now using surface mount. That figure will rise to 65% by 1992, Electronic Trend says.

One early U. S. surface-mount adherent was General Motors' Delco Electronics Corp. The Kokomo, Ind., unit, a subsidiary of GM/Hughes Electronics Corp., began converting its internal production lines in 1979 and today uses surface-mount technology for more than 90% of its products. Delco has spent $60 million to $70 million on surface-mount equipment just since 1982, and currently has the capacity to place 17 million surface-mount components per day, says Daniel K. Ward, supervisor of Delco's Advanced Process Development Group.

Also moving into surface mount is AT&T Co. All of its factories have surface-mount capability along with through-hole technology, says Larry Siefert, vice president of engineering, and all new designs use surface mount. Adapting older products to surface mount is done as design changes dictate.

Siefert can't estimate the proportion of surface-mount versus through-hole manufacturing in AT&T's operations. But he says all of its consumer products use the technology because of its space-saving advantages. In fact, the thriving consumer electronics business in Japan gave that country its head start in surface mounting, Siefert says.

In computer, commercial, and industrial electronics, on the other hand, size generally is not a key consideration. Therefore, Siefert says, AT&T products such as, say, multiplexers use it if they gain in speed and performance as a result. Digital multiplexers used in lightwave transmission, for example, handle data rates of 2 gigabytes/s and above, and that calls for reducing the number of packages and placing them as close together as possible—one of the big advantages of surface-mount technology.


Delco uses surface mount for more than 90% of its products, which include this auto body-control module containing some 675 surface-mounted devices.

Still, most U. S. firms have resisted converting their internal lines due to the high capital costs of surface-mount equipment, the complexity of the process, and a shortage of trained surface-mount personnel. A state-of-the-art, high-volume automated surface-mount line requires a $1.5 million to $2 million equipment investment.

At AT&T, Siefert says, the production equipment itself did not pose a major barrier to adopting the technology because "most of our costs are in testing and inventory." However, the learning curve for training people in the use of surface-mount technology is a factor. "You have to convert all your computer-aided-design systems to surface mount," he says, "and that involves new design rules and double-sided boards. Training costs became an issue in training designers, not on the manufacturing end."

A FINE LINE. One complicating factor is the emergence of new, finer-pitch surface-mount package families, with lead spacings of 15, 20, and 25 mils, center to center [*Electronics*, October 1988, p. 112]. Today's mainstream 50-mil pitch packaging can accommodate a maximum of only 84 leads. And the new fine-pitch packages are a necessity for very large-

Double-sided surface-mount assembly boards undergo solder inspection at one of the facilities run by Texas Instruments, which does both in-house and contract work.

Mangin says. And with surface-mount business already booming, the merchant assemblers are investing heavily to maintain their flexibility and meet the growing demand.

The biggest of the bunch is SCI Systems Inc. The Huntsville, Ala., firm saw revenues jump 40%, from $552 million to $774 million in the year ended June 30. And 60% to 70% of that growth came from surface contract work, says SCI's president, A. Eugene Sapp. Within the surface-mount category, Sapp adds, fine-pitch work is the fastest-growing portion. "We do fine-pitch assembly in most of our plants, with most of what we see today being at 20 to 25 mils," Sapp reports.

Besides Huntsville and two other locations in Alabama, SCI has manufacturing facilities in Milpitas, Calif.; Graham, N. C.; Scotland; Singapore; and Bangkok. In all, the company has 33 surface-mount manufacturing lines, with plans to install 13 more at a cost of about $20 million by next summer, Sapp says. "We probably have $40 million to $50 million in equipment today, and we place about 10 million parts per day," he says. SCI will also soon add two through-hole manufacturing lines to the 28 it already has in place. But "in the past year," Sapp points out, "our SMT lines have surpassed our pin-and-hole lines in numbers." Sapp doesn't name customers, but it is widely known that IBM is one major name on the list.

The revenue and investment numbers tell the same kind of story at other shops. At Flextronics, for example, Stratford says that surface-mount work already accounts for 40% of the firm's sales, and is growing at a 250% to 300% annual rate. Overall, Flextronics revenue is now running at more than $200 million annually, he says. The firm invested about $17 million in surface-mount equipment last year and will spend about the same amount in 1988, Stratford says.

At Philips, which is devoted exclusively to surface-mount work, Pukaite won't provide sales figures. But he says that business has grown sixty-fold over the past three years. The firm has the capacity to place up to 1 million components per hour, and is currently running at a rate of 3.1 million to 3.5 million a day, Pukaite says. Philips has invested $15 million in equipment, and plans to spend more.

MOVING IN. Even some of the big equipment houses are getting in on the action. Texas Instruments Inc., for example, has been ramping up its own surface-mount assembly for five years to meet internal needs. But the Dallas firm also offers merchant surface-mount assembly services to outsiders at locations in Austin, Dallas, Houston, and Johnson City, Tenn.

For the near term at least, the heavy investments by contract manufacturers is helping to fuel growth for U. S. vendors of surface-mount automation gear. A full surface-mount line requires equipment for screen printing, component placement, soldering, cleaning, inspection, testing, and repair/rework. Electronic Trend projects that contractors' spending for surface-mount gear will rise by 22.1% annually over the next few years, from $111.2 million in 1987 to $301.6 million in 1992. Surface-mount equipment purchases by U. S. electronic equipment manufacturers will also grow at a 21.6% clip, from $170.5 million last year to $453.9 million in 1992.

By 1992, revenue from surface-mount may exceed revenue from through-hole

"Consumption of SMT equipment by contractors will be exceptionally high through 1989, as electronic equipment manufacturers turn to contractors for early SMT assembly to avoid large capital expenditures on assembly equipment," says Electronic Trend. "From 1990 through 1992, however, the electronic equipment manufacturers' consumption rate will grow more quickly, as these companies gain both expertise in SMT assembly and capital necessary to purchase their own SMT lines."

In fact, some see hard times coming for the contract manufacturers. The current upswing in merchant surface-mount work "is only a temporary boom," maintains Linda J. Jardine, an industry watcher at ElectroniCast Corp., in San Mateo, Calif. For technologies such as surface mount that require a long learning period, "the smaller guys will use subcontractors at first, and when all the bugs are worked out, they'll bring it all in house," Jardine says. "When the next recession comes, the merchant contractors will lose all that business, and they'll never return to the same volumes."

Not surprisingly, the contract manufacturers disagree. "We work to contracts and we buy inventory to support actual orders, so we can react rapidly to upturns and downturns," says Sapp at SCI Systems.

"If we do have a slump, the contract houses are probably going to suffer a little more and a little earlier," concedes Philips' Pukaite. "But on the other side, when a downturn turns back up, the contractors are probably going to recover a little bit faster."

And other industry watchers agree. "I think equipment manufacturers will continue to do some manufacturing internally," says Dataquest's Francis. "But they can't do it as cost-effectively inside as they can get it done outside. People who say they're going to pull it all back inside have got to be crazy."

By making big investments in surface-mount talent and leading-edge equipment, the contract manufacturers will also have an edge, Francis maintains. "Firms like SCI are already investing in tape-automated bonding," he says, which is likely to be one of the next big trends in electronics assembly. "The hands-on experience of the contract manufacturers is their best insurance for the future," adds Mangin, of Ceeris.

Additional reporting by Lawrence Curran, Jack Shandle, and Larry Waller

WOOING POST-CRASH VENTURE CAPITAL

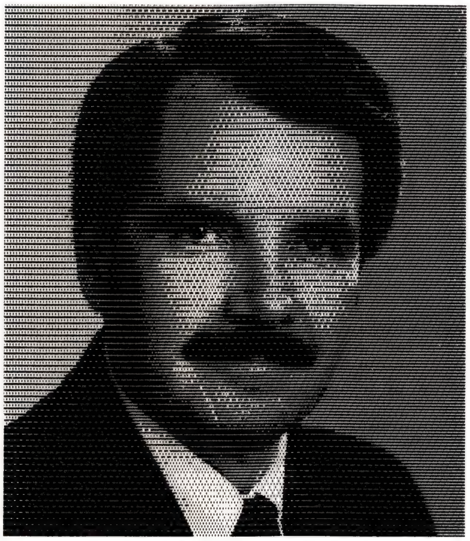
One year after the Event—Wall Street's euphemism for the stock market crash of Oct. 19, 1987—a would-be entrepreneur might expect to find venture capital sources dried up. On the contrary—notwithstanding the crash, 1987 turned out to be a record year for investing in venture capital mutual funds: 110 different funds raised $4.2 billion. And over the past three years, more than $10 billion has been committed to venture capital mutual funds with much of the money still remaining to be invested in new businesses.

This is not to say that what happened on that Monday left no scars on the venture-capital community. For one thing, technology lost some of its lure for the investor. For another, an air of caution settled over the venture capitalists themselves.

Where exactly does that leave the thinking in the high-technology sector of venture capital? And in light of that thinking, what are the issues that should be of concern to managers and engineers who want to start their own technology-based businesses?

To answer those questions one must first understand what has changed in the last year. The most immediate result of the 1987 crash was an overnight revaluation by the public markets of technology-based businesses. That's understandable: in a period of two or three days, many young technology companies saw as much as half of their value disappear. This had a traumatic effect on young companies planning either an initial public offering or a later-stage private financing. Investors in general and venture capital investors in particular developed a cautious investment strategy. Some venture capital investors began buying back stocks in some of their publicly traded companies in the belief that these stocks were so cheap they represented a better value than startups in terms of the risk : reward ratio.

The reduced value placed on publicly traded companies also increased interest in leveraged-buyout opportunities. Entrepreneurs trying to get their businesses funded found themselves competing in a totally new environment characterized as being both unusually cautious and at the same time noisy. On top of this, the significant increase in the pool of investable funds has required venture capital managers to focus on investment opportunities where large amounts of money can be put to work. But startup opportunities, by comparison, require smaller dollar investments and are time intensive. For this reason the startup investment opportunity can easily slip to the bottom of the pile. To gain a fair hearing amid all the noise, entrepreneurs need to develop a strategy.



JON W. BAYLESS

Age: 48
Partner, Sevin Rosen Bayless Venture Fund
Career path: Director, Arthur A. Collins Inc., R&D lab developing digital telephony, 1974-81. Research scientist at Defense Communications Agency, 1970-74.

BAYLESS'S STANCE:

"Anybody with a good idea and a good team can get funded."

Here are some of the basic rules to follow—and what to avoid—when going out to look for capital. First, a list of the don'ts:

- Don't prepare an extensively printed, fancily bound business plan full of glossy photographs and rosy projections. Such documents are useful for training new MBA graduates but quickly find their way to the circular file in venture offices.
- Don't allow a third party to represent you or to develop your business model. The venture investor wants to understand how *you* think and wants everyone involved in developing the business concept to be committed to its successful execution. A third party who is not committing his future to the business has no part to play in the process. Third-party involvement is frequently a reason for a project to lose the consideration it may deserve.
- Don't be insecure about your own position in the proposed new business. The best way not to get the funding for your project is to request guarantees in the event of failure.

Now that we have the don't in mind, let's talk about some of the positive steps you can take to get the time, attention, and funding your project needs:

- Do develop a strategy for approaching the venture partners that you think can provide the greatest help in making your project successful. In venture capital, as in other fields, there are leaders and followers. Focus your efforts on potential venture partners who have a reputation for being decisive and who will commit time to your project.
- Do identify a complete management team that includes all the skills necessary to develop successful products and run a business. Every member of the management team should have a demonstrable history of success.
- Do think through your business concept enough so you are able to articulate it concisely. Find and develop quantitative data that defines your market niche. Clearly define the advantage your team will have over the competition to develop and defend that niche.
- Do think through every risk in your proposed business and identify strategies that minimize those risks and maximize your probability of success. Be prepared to discuss the risks and the potential competition in addition to stressing your chances for success.
- Do sell yourself and your team. With the right team you can generate interest on the part of the venture investor with just a short discussion. The venture partner will want to interact with you to fully develop your business concept and establish an operating plan for your business. This plan will not be a sales document created for the purpose of raising funds. It will be the op-

ACL from Philips. It's logical.

Using advances in fabrication technology, moving from six to three to one micron effective gate lengths, Philips CMOS logic now operates at speeds offered by the most advanced bipolar families, yet with all CMOS benefits.

That's Advanced CMOS Logic (ACL) from Philips. With an average gate propagation delay of 3 ns (150 MHz operation) and 24 mA output sink/source capability, Philips ACL allows designers to implement CMOS benefits across the whole speed spectrum of logic circuitry.

New pinning for a new technology.

Traditional IC pinouts, with supply pins at diagonally opposite corners, are a remnant from the days of single-sided print boards. They are inherently unsuitable for Advanced CMOS Logic, producing supply and ground noise resulting in reduction of system noise margins, loss of stored data and lower system speed. Philips ACL has multiple supply pins at the centre of each side of the package, the input pins on one side of the package, the output pins on the other side and control pins at the corners.

The result is improved system reliability, simplified design and reduced board area.

All Philips ACL ICs (74 AC/ACT 11XXX family) are available not only in 300 mil wide DIL packages but also in SO packages, so you can use surface mounting techniques to increase pcb packing density even further.

If you'd like full information on this important logic development, just contact your nearest Philips office.

For Advanced CMOS Logic, the name is Philips.

Circle 123

Philips Components, Marketing Communications, Building BA, P.O. Box 218,
5600 MD Eindhoven, The Netherlands. Telex: 35000 phtc nl/nl jevmc

PHILIPS

PHILIPS

HERE'S HOW TO PUSH QUALITY TO NEXT LEVEL

The latest method involves everyone in the company

by Larry Waller

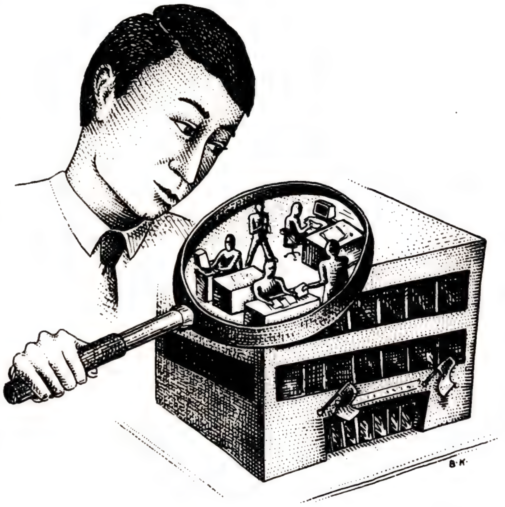
Nearly a decade ago, any U. S. high-technology company without a quality-assurance program risked being blown away by the products from overseas—mainly Japanese products—that boasted consistent high quality. U. S. companies painfully and quickly learned they needed to keep pace with the foreign competitors intent on cracking U. S. markets.

Their massive effort to upgrade quality assurance has in many cases paid off with products that are better in every way, but now U. S. managers are discovering that they must again make radical changes to keep up. This time, the emphasis is on a methodology that extends the focus on quality way beyond the product itself. Authorities in the field call it "total quality" and say it is fast emerging as what will undoubtedly be a crucial element in successful competition with offshore rivals. The time is here, they say, to institute total quality across the board—or else.

The concept is so simple that, once grasped, it catches on rapidly because it is the logical follow-up for firms already committed to turning out superior goods. Total quality overlays and augments all the other productivity programs already in place. Besides quality assurance, these include just-in-time delivery, computer-integrated manufacturing, design for manufacturability, and electronic data interchange. Simply put, it is based on a broad view that every person in every part of a company has a role in making operations better, and lays out a systematic method to do the job.

"It really is a total attitude that means the participation and awareness of every employee in every aspect of the company works to improve things," notes H. David Law, vice president at PCO Inc., who heads total quality at the Chatsworth, Calif., manufacturer of fiber-optic system components. Like many of its U. S. high-tech peers, PCO plunged into total quality only recently. But since its program got under way in April, the Corning Glass Co. subsidiary has become an enthusiastic convert because the benefits quickly became apparent.

Law points out that the company's entire staff must be involved since in a typical high-tech operation, only about 15% of the employees actually touch the product itself. But the other 85%, because they work closely with customers in such key service areas as shipping, billing, and sales, are equally important.



But just as when Americans suddenly became aware of the competitive value of the product-quality concept nearly a decade ago, they are finding the Japanese far ahead with total-quality programs. Law theorizes that the concept comes naturally in a nation where such an approach seems "a part of their culture." He says "they were doing it 15 years ago."

By contrast, the path to total quality in the U. S. is more difficult because the practice here is to separate tasks by department. For example, unifying the approach by making the engineering department work closely with sales and manufacturing was a knotty problem for many manufacturers even before the quality issue ever existed.

Even though the value of total quality seems apparent, a new survey taking the first detailed look at how U. S. companies deal with productivity shows them lagging in putting the concept into operation. Of the 209 companies responding to the survey compiled for the American Electronics Association by KPMG, New York-based Peat Marwick Mitchell & Co.'s, high-technology office in Los Angeles, only about one third report having started full-blown total-quality programs.

The slow start is all the more surprising since officials at the companies recognize quality as the most important factor in worldwide success, notes Kevin Steele. He is a director at the Costa Mesa, Calif., office of Pittiglio Rabin Todd & McGrath, a Mountain View, Calif.-based consultant that specializes in manufacturing operations, and has helped set up many total-quality programs. It wrote the report for Peat Marwick. "This survey indicates that American companies are having difficulty competing with foreign manufacturers on that front," says Steele.

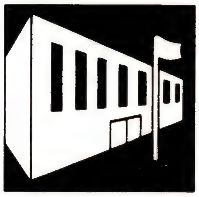
He speculates that one reason for the lag is that most U. S. companies still do not realize how fast such programs can pay off. "Companies we work with really have seen dramatic results, with breakthrough improvements, and not just gradually," notes Steele. As an example he cites one client that reduced total product costs by 36%, another that cut rework and scrap by 90%, and a third that saw rejected products drop from 40% to less than 5%, all in the first stages of the program.

PCO's Law has no doubts about the worth of total quality. PCO realized early that its competition was offshore and included the toughest rivals anywhere, the likes of NEC and Hitachi. "So we committed ourselves to the concept of total quality," which in his view "is nothing less than a survival kit for U. S. A. Inc."

The methods of installing it are straightforward and available from a number of consultants. Generally, they require leaders to be trained first, who then spread the word and techniques throughout the company. Corning Glass, which is a pioneer in the field, helped PCO get started. Quality circles, where groups meet regularly to discuss and push for improvements, play a key role, along with teams made up of cross sections of company personnel, set up to address specific problems. Along with building this formal structure, setting and meeting goals laid out by the teams, the fundamental objective is to make every employee aware that total quality requires a con-

THE UNIX CONTROVERSY GOES ON AS OSF CLOSES IN ON A STANDARD

The nonprofit consortium faces opposing group backing AT&T's version



CAMBRIDGE, MASS.

Spawned in controversy, the Open Software Foundation appears destined for contention as it churns toward developing a vendor-neutral and truly open Unix operating environment. Unless there's a major compromise between OSF and a rival consortium backing AT&T's Unix System V version 4, it looks as if Unix system vendors will have to choose between two standards—OSF-1 and System V.4.

That likelihood emerged last month in the wake of formation of the 18-member group allied with AT&T, hardening the Unix world into two camps [*Electronics*, Nov. 1988, p. 30]. The rosters are impressive. OSF includes more than 50 companies, among them Advanced Micro Devices, Apollo, Data General, Digital Equipment, Groupe Bull, Hewlett-Packard, IBM, Mentor Graphics, National Semiconductor, Nixdorf, Siemens, Toshiba America, and Wang. The opposing 18-member group includes Amdahl, ICL, Intel, Lachman Associates, Motorola, Sun Microsystems, Unisoft, and Unisys.

It is too early to tell what step the combatants will take next. An OSF spokesperson says his organization can't comment intelligently about the new consortium "because we haven't seen any details that tell us anything about their charter or goals. We don't know what they intend to do, but their existence in no way changes our mission or timetable."

THE MISSION. That mission is formidable. Founded last May, OSF intends to become the computer industry's first member-sponsored research and development organization aimed at winning global acceptance for a single operating-environment standard for Unix-based systems. In its brief existence, OSF has gained a diverse reputation. It is the symbol of hope shared by its members that its mission will be accomplished, and it has become a lightning rod for controversy to members of the new consortium.

OSF executives already can look back over seven months and point to major accomplishments. OSF has asked for and received acceptable technical proposals from 23 organizations for its planned Unix user interface; begun development of its OSF-1 operating system, which will be based on core technology from a future version of IBM Corp.'s AIX; expanded its rolls from the original seven sponsoring firms; moved to permanent headquarters in Cambridge, Mass.; and embarked on an ambitious timetable intended to have OSF-1 on the market in 12 to 18 months.

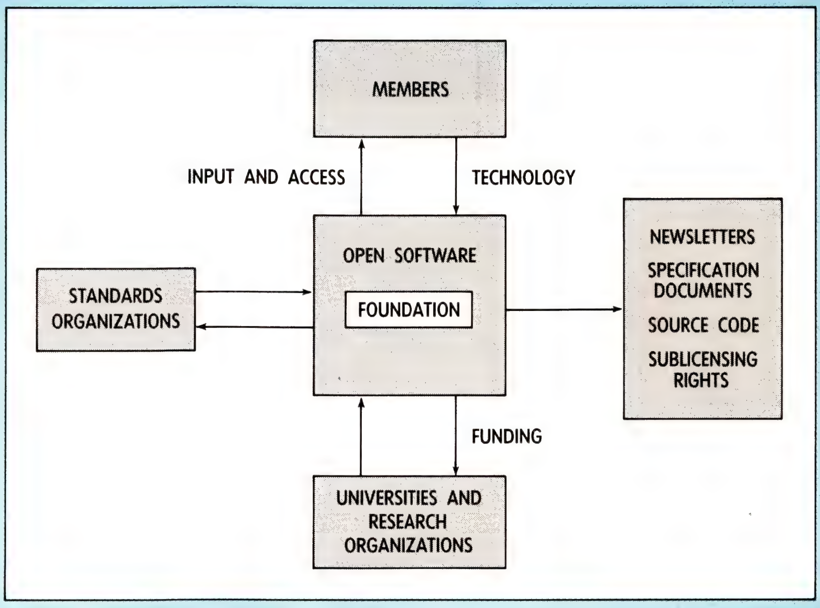
How does this member-sponsored R&D organization see itself? "We're unique," says OSF's first president, Henry Crouse, "loaned" to the organization by Digital Equipment Corp. "We're not for profit, but not for loss, either. We have a business plan, but this is a new kind of vehicle, something the Harvard Business School will write about."

Crouse says the plan calls for OSF to employ 250 by the end of 1989, a number he sees growing to 300 to 400 in four to five years. "We're projecting a $200-million revenue stream in year four. We signed a five-year lease with a five-year option on this facility, so I guess we'll be in business for a while." OSF will realize its revenues from member dues—the ceiling is $25,000 per year for for-profit companies—and from license fees for OSF-1 and later versions as well as from consulting, porting, and other services.

MORE THAN STANDARDS. But OSF is not a standards body, says Donald O'Shea, recently named vice president for operations and communications. He was chief executive officer at Unisoft Corp., an Emeryville, Calif., Unix system and custom engineering vendor. O'Shea adds, "We will influence those bodies. The industry can't wait three to four years for a [Unix] standard to evolve. We'll conform to standards in developing an industrial-strength version of Unix that people can risk basing their business on."

Another new arrival, Ira Goldstein, OSF director of research and a 10-year senior technologist at Hewlett-Packard Co.,

AT OSF, DATA FLOWS BOTH WAYS



Though OSF's first task is to establish a Unix standard, it emphasizes that it is not just a standards group. As its organization chart shows, it also will be heavily involved in research.

AURA BRINGS ESOTERIC TECHNOLOGY TO FRONT LINES

LOS ANGELES

With military procurement budgets either on hold or growing slowly, and with precious few new, big programs in the wings, conventional wisdom holds that these are the worst of times for a startup aiming at the military market.

But Aura Systems is bucking that trend with fast growth based on mastering a unique core technology—magnetic suspension—and recognizing that the absence of new funding has the defense community looking for some less expensive ways that they can use to deliver cutting-edge performance.

"There has never been more opportunity than now," says president Zvi (Harry) Kurtzman. Because the military cannot soon replace its workhorse aircraft, ships, and weapons platforms, it's receptive to ideas which lead to affordable hardware that will improve old systems' performance. Although such upgrading has always taken place, it has historically taken a back seat to spending sprees for new equipment. Now events have forced it to the top of the priority list, says Kurtzman, "to take existing systems and make them better."

The attraction of magnetic suspension is that it makes it possible for objects to be levitated, or "free-floated," in the magnetic field. The payoff comes from virtually eliminating effects such as friction, vibration, and heat. But while the technology has been known for much of this century, it has seldom been used because of difficulties in building, packaging, and accurately controlling it.

JUICY PROSPECTS. In the tough climate of slim defense budgets, Aura's record—skyrocketing to an approximately $10 million annual sales rate from zero in 1987—will soon be attracting attention to the Los Angeles, Calif.-based company. And Kurtzman's assessment of the military's quandary is seconded by defense analyst Wolfgang DeMisch of the Union Bank of Switzerland in New York. Slashed budgets "mean they can't replace existing fleets," he says, "so the logical thing is . . . to juice them up."

Because Aura is still relatively unknown outside a handful of aerospace firms and a cadre of Pentagon procurement people, DeMisch has not yet studied it in depth. But he thinks the timing might be right for small companies with solid credentials to win a growing share of military work against some of the much larger competitors.

The award of a $5.1-million contract in September should earn Aura wider industry notice. The firm beat out a number of heavyweight rivals to build a facility for simulating incoming ballistic missiles and testing sensors for the Strategic Defense Initiative [*Electronics*, Oct. 1988, p. 62]. To be located at Eglin Air Force Base in Florida, the project initially will use a three-axis flight-motion simulator to position the missile. Later Aura will replace it with magnetic-suspension equipment.

Aura was quick off the mark from its founding in early 1987 to go after the widening niche, which seems particularly ripe for its specialty. Resulting from work performed over the previous five years at several tiny predecessor companies, the magnetic-suspension technology has the advantage of the latest digital techniques, developed by Aura to control objects suspended magnetically.

Aura blends magnetic suspension with digital control for the military

Aura scientists—who, like Kurtzman and his cofounders, mostly came from GMHE/Hughes Aircraft Co.—use off-the-shelf processing chips for the controls, packaged on a circuit card. But custom devices now being developed will cut the parts count to a few components. Development required a new kind of servomechanism control software, and the circuitry also includes a power amplifier to drive current through the electromagnetic coils that generate the magnetic field.

Though magnetic suspension has long been regarded as something of a visionary field, with real uses remaining far in the future, Aura has been able to sell some tough military customers on it. For example, General Dynamics Corp. of St. Louis, Mo., picked the company to build a magnetic gimbal for its F-16 aircraft.

The goal is to improve the clarity and resolution of existing electro-optical sensors by floating them in the gimbal's magnetic field, thus isolating them from jitter or vibration. And Aura has teamed up with TRW Inc. of Cleveland, Ohio, in a proposal for an advanced technology system for submarines. Among other improvements, the system reduces vibration-related signature emissions, thereby decreasing the chance of the undersea

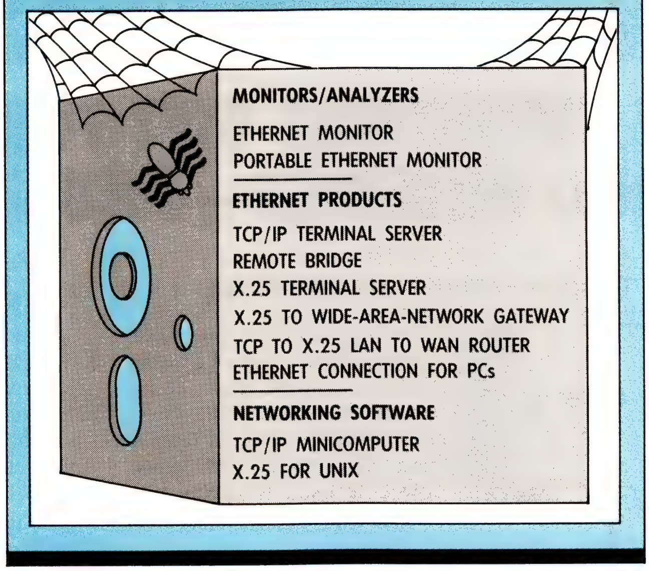
What Analog CAE System Finds The 10¢ Part That Will Cost You Millions in Warranty Repairs?

To find out, turn the page.

tailors SpiderMonitors for a niche—local-area-network managers who need to optimize their network's use but who shun high-end protocol analysis.

SpiderMonitors offer about 90% of the protocol-analysis functionality of competing products from Network General Inc., Mountain View, Calif., and Excelan Corp., San Jose, Calif., says Martin Ritchie, Spider Systems' vice president of marketing. "We don't have the same level of protocol decode as Network General, but we give more statistical information, which gives a manager an overall view of his network." The analyzers help managers pinpoint physical-connection problems such as cable malfunctions, or identify overloaded network segments that can be fixed by a local bridge, for example. Priced at $7,850, the K150 is the first network monitor to sell for less than $10,000 in the U. S., says Ritchie.

SPIDER'S WEB OF PRODUCTS



MONITORS/ANALYZERS

ETHERNET MONITOR
PORTABLE ETHERNET MONITOR

ETHERNET PRODUCTS

TCP/IP TERMINAL SERVER
REMOTE BRIDGE
X.25 TERMINAL SERVER
X.25 TO WIDE-AREA-NETWORK GATEWAY
TCP TO X.25 LAN TO WAN ROUTER
ETHERNET CONNECTION FOR PCs

NETWORKING SOFTWARE

TCP/IP MINICOMPUTER
X.25 FOR UNIX

Unlike the competition, SpiderMonitors do not dedicate the personal computer platform exclusively to data collection. Statistics collection and packet filtering can take place in the background while the PC is used for other tasks. All in all, it is more of a general-purpose instrument than its competition, which targets network software designers who need a rigorous debugging tool. "The people at Digital Equipment Corp. told us they use SpiderMonitors on a day-to-day basis," says Ritchie, "and they get the full-featured analyzers out of the closet when they really have a problem."

NEW IDEAS. He knows that business is conducted differently in the U. S. and Europe, but CEO Palmer contends that Spider is ready for the challenge. "In the U. S., people like answers quickly," he says. "They are much more interested in taking on new ideas. In Europe, they wait longer and want more proof." Both Palmer and Ritchie once worked in the U. S. for the UK computer maker International Computers Ltd. Palmer ran ICL's New York State operations for a year, and Ritchie had a similar position in Pittsburgh.

Both returned to Scotland in time to see ICL announce it was closing the development laboratory where they worked alongside the other three Spider founders—vice president of technology Andy Davis and senior engineers John Martin and Nick Felisiak. Rather than move south with their new job offers, the five decided to start their own company. For the first two years, they developed software under subcontracts, using their profits to support the development of the SpiderMonitor. It was introduced in 1986.

"People think you have to have venture capital," says Palmer, "but when I went to see the venture capitalists, they asked me to write a business plan and then wait six months before they would decide whether or not they would give us any money. I said I wanted to start the business tomorrow."

Other Spider products include a TCP/IP terminal server, a remote bridge, an X.25 terminal server, and networking software for Unix systems. Except for board-level fabrication and assembly, Spider does all its design and manufacturing in-house. "Our product reliability is as good as anybody's," says Palmer. "Our products are leading-edge yet easy to manufacture. We don't stretch tolerances too far and we design for maximum reliability." For example, he says, "our products are deliberately designed without fans, because that is the most unreliable element."

The founders chose the name Spider Systems because "we wanted a name people wouldn't forget," says Palmer. In addition, the name alludes to a story of Scotland's national hero Robert Bruce, who, after losing a major battle, watched a spider patiently spin its web over and over, no matter how often the wind tore its work to shreds. Finally, the spider succeeded. "The try-and-try-again theme has been with us all along," says Palmer.

–Jack Shandle

What Analog CAE System Lets You Eliminate The Profit Pirates From Your Product Design?

To find out, turn the page.

Freestyle from August 1986 to September 1987. By then, "it was time to deliver something. Horace said he'd be our first alpha user and that he was really going to give the system a workout. And he wanted it by Christmas." Levine reports that Tsiang was delighted with his Christmas present. In fact, "he has used it every day since then—to approve all travel requests in his 3,000-person department," among other things.

Unlike Tsiang, however, customers won't get Freestyle free, and some analysts say it costs too much. A minimal version—electronic tablet and pencil, interface board, software, and cable—sells for $1,995. Incorporating the voice-interface card and handset, voice software, and cable adds $1,495.

"Freestyle is a fresh approach to executive productivity that doesn't come cheap," says Scott McCready, an associate director at CAP International Inc., a Norwell, Mass., market research firm. However, he adds that the system "is to business what the Next computer will be to education in two to three years." McCready refers to the computer introduced in October, and aimed at the college market, by the new company formed by Stephen Jobs, one of the founders of Apple Computer Inc.

However, McReady adds, Freestyle could be a seminal product: "Simply put, it turns a PC into a document-creation, revision, and output factory." He cautions potential competitors not to underestimate the system, despite its price.

Levine sums up his rationale in designing the new system by saying that Freestyle "extends simple interpersonal communication to computers. Users can write, talk, or type into the system, depending on what they like to do. It's computing as you like it," he concludes, adding with a Santa-like twinkle, "Shakespeare himself undoubtedly would have loved it." *–Lawrence Curran*

CABRAL GUIDES MICOM AS IT GOES PRIVATE

SIMI VALLEY, CALIF.

Turning around a high-flying company that has fallen on hard times poses a stiff enough challenge in itself, as Gilbert Cabral acknowledges. But the drama at Micom Communications Corp. is about more than restoring the financial health of this leading supplier of data-communications products.

The real story, one that should attract much industry attention, is that Micom is among the first in the business to go private. It thus could be a bellwether for other companies beset by business problems and sagging stock prices and that are considering buying back their shares. How newly named president and chief executive officer Cabral, Micom, and its owner, New York-based Odyssey Partners, handle the transition is therefore of acute interest.

As far as Cabral is concerned, the advantages of being a privately held company are many. Gone are all the financial-reporting requirements, as well as the time and treasury drains of dealing with thousands of shareholders. In addition, there is no board of directors to answer to. "It's a tremendous load off our shoulders," he says.

Doing away with niggling detail work is "a load off our shoulders," says Gilbert Cabral

But the biggest payoff from going private should come from the freedom from quarterly financial-performance measurments, a feature that many observers believe puts American companies at severe competitive disadvantage with foreign rivals. Cabral agrees with this view, adding, "We can address things in the long term now." Most important, having owners that share that view allows "making the tough decisions that are necessary to take the company back to its previous levels of profitability," a much easier task.

He observes that running a company

What Analog CAE System Can Tell if Your System Will Survive in Real-World Conditions?

To find out, turn the page.

for the long term "requires a different management style than in the past and that's what I'm trying to build here." The choice of Cabral, 41, as president and CEO by Odyssey surprised some since he was not among the top-level managers at Micom previously. He served most recently as vice president for manufacturing. But he posseses the skills that Odyssey puts at the top of its list, says Stephen Apkon, an associate at the private investment partnership.

"His manufacturing background demonstrates the focus on product quality we have to have, and Gil in the past always has delivered excellent results," says Apkon. "He is a very strong manager, with a high energy level."

Cabral's education and most of his jobs were centered in financial management, including a stint as controller at Micom, but he has vast experience running entire operations, notably the Latin American interests of GTE Corp., for several years in the 1970s and 1980s. These GTE units are run as separate firms in each country, posing management problems peculiar to the unstable Latin scene.

SURVIVAL. "Latin America taught me how to survive [anywhere]," he says. Most difficult was coping with employee kidnappings in Colombia. On the opposite end of the job spectrum, and as a way to relax a bit after his South American experiences, Cabral managed a large dairy in Vermont, where "I did everything."

That thinking is evidenced in the new management style taking over at Micom, which stems from Cabral's conviction that turning out top products calls for involvement from every employee from top to bottom. This runs counter to Micom's past practice of having everything rigidly structured along traditional lines. "I'm no industry guru; here everybody runs [the company]," he says.

Also, he is embracing the new participatory management methods. In only the few months since he took over, response has been heartening and employees are enthusiastic, according to other managers there.

But no one at Micom thinks a mere tightening will solve the company's problems. He and Odyssey have concluded that most of the company's troubles basically stemmed from too-speedy growth. Although acquisitions took Micom into fields that are related to building data-communications gear, fields like local-area networks, the new subsidiaries had problems of their own that diverted time and energy from the parent. (The company holds over 40% of the statistical multiplexer and data switch market, according to one industry estimate, with some 200,000 multiplexers sold and 3,600 switches installed.)

The solution is cutting size, then building slowly, Cabral explains. Already sold is a telephone switching equipment unit; a catalog business and LAN company have been carved out to be put on the block. As a result, Micom has been halved from $220 million in sales. "The trick is to think small, look at what made us successful, and get back there. Smaller is happier, in our case," says Cabral. He maintains that growth is still in the picture, and Micom will spend approximately 9% of sales on research and development. "But the difference is that we'll grow from strength this time, going for lots of hits, rather than the home run," he says.

Although short-term thinking is a thing of the past, Cabral's most immediate task is to get the company back into the black. More operation-cutting looms, especially in the plant that was built in Simi Valley in anticipation of an expansion that never came. "We've made some tough decisions and more are to be made," says Cabral. *–Larry Waller*

For The Questions That Really Matter, Analog Workbench™ Is The Only Answer.

Analog Workbench is the industry's best-selling analog design tool. Not because we get the basics right, although we do. Because we do more to solve real-world problems.

Other analog CAE systems predict how a design will perform as a prototype. Only Analog Workbench predicts how a design will yield in production. What changes will cut production costs. And what parts might fail under stress. In short, it'll tell you more about your product and its future faster than ever before.

Find out why customers feel the Analog Workbench was a profitable investment. For a package of testimonials, call 1-800-ANALOG-4.

ANALOG
DESIGN
TOOLS

1080 E. Arques Ave., Sunnyvale, CA 94086, 1-800-ANALOG-4 or 408-737-7300

IPPC, SBC
IEC, IBC
IEPC, HSCC, SBC, IBC,
IEC, IDEC™, EPIC™
Network Termination
IOM™-2
S
S Transceiver
U Transceiver
U
Line card
S or U
Transceiver
IOM™-2
PCM Interface
Transceiver
LAPD
Line Card Controller

U.S. Postal Service

Statement of Ownership, Management, and Circulation

(Required by 39 U.S.C 3685)

1. **Title of publication:** Electronics

   A. Publication number: 172-400

2. **Date of filing:** September 30, 1988

3. **Frequency of issue:** Monthly

   A. Number of issues published annually: 12

   B. Annual subscription price: $60.00

4. **Mailing address of known office of publication:** Ten Holland Drive, Hasbrouck Heights, N.J. 07604

5. **Mailing address of the headquarters of general business offices of the publishers:** Ten Holland Drive, Hasbrouck Heights, N.J. 07604

6. **Names and mailing address of publisher, editor, and managing editors:**

   Publisher: James Uhl, Ten Holland Drive, Hasbrouck Heights, N.J. 07604

   Editor: J. Robert Lineback, Ten Holland Drive, Hasbrouck Heights, N.J. 07604

   Managing Editor: Howard Wolff, Ten Holland Drive, Hasbrouck Heights, N.J. 07604

7. **Name and address of owner:** VNU Business Publications Inc., Ten Holland Drive, Hasbrouck Heights, N.J. 07604

   Name and address of stockholder owning or holding 1 percent or more of total amount of stocks: None

8. **Known bondholders, mortgages, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities:** None

9. **Nonprofit status:** Not applicable

10. **Extent and nature of circulation:**

	Average number of copies of each issue during preceding 12 months	**Actual number of copies of single issue published nearest to filing data**
A. Total number of copies	136,807	105,098
B. Paid and/or requested circulation		
1. Sales through dealers and carriers, street vendors, and counter sales	None	None
2. Mail subscription	121,970	83,838
C. Total paid and/or requested circulation	121,970	83,838
D. Free distribution by mail, carrier, or other means; samples, complimentary, and other free copies	4,891	17,060
E. Total distribution	126,861	100,898
F. Copies not distributed 1. Office use, leftover, unaccounted, spoiled after printing	9,946	4,200
2. Return from news agents	None	None
G. Total	136,807	105,098

11. **I certify that the statements made by me above are correct and complete.**

Denise M. Teeling

Business Manager
Denise M. Teeling

MILESTONES

SYMBOLICS REBOUNDS FROM PROFIT DROUGHT

For the first time in two years, Symbolics Inc. is showing signs of rebounding from financial setbacks. The Cambridge, Mass., supplier of symbolic-processing systems reported a net profit of $415,000 in the first quarter of fiscal 1989, which ended Oct. 1. That compares with a net loss for the first quarter of 1988 of almost $4.5 million.

The profits came after Jay Wurts, Symbolics chairman and chief executive officer [*Electronics,* Aug. 1988, p. 128], instituted tight cost controls, including a substantial layoff. He says things should continue to improve because the company's new products, including those incorporating the 32-bit Ivory symbolic microprocessor, are just beginning to ship.

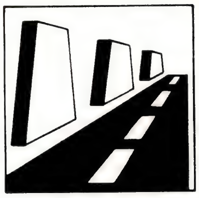
SUN DECLARES ITS FIRST SPLIT

Santa Claus will arrive a bit early for Sun Microsystems Inc. stockholders. The Mountain View, Calif., maker of work stations has declared its first stock split ever, a 2-for-1 deal, to be issued about Dec. 20 to stockholders of record on Nov. 28. At the end of the first quarter ending Sept. 30, more than 41 million shares were outstanding. The reason for the split: the company hopes to attract the more stable smaller investors rather than the quick-to-trade institutional investors such as banks, insurance companies, and pension funds.

SGS UNIT SIGNS A DEAL WITH OLIN

It's a strategic alliance that appears to be a marriage made in technology heaven. Olin Corp., Stamford, Conn., which makes chemicals and materials for chip makers, and Innovative Silicon Technology, which makes chips, have signed an agreement to cooperate in certain areas. Innovative Silicon, part of the SGS Thomson Microelectronics Group, is located in Agrate, Italy, and fabricates application-specific ICs. The two companies plan to pinpoint global chip trends and develop materials, as well as processes, to address them.

HP STREAMLINES COMPUTER OPERATIONS



Hewlett-Packard Co. has cut to two from three the number of business units that make up its computer-product operations. The Palo Alto, Calif.-based firm has left untouched its other operations—one devoted to computer marketing, sales and support, and another to the instrumentation and measurement business. The new units are the Computer Products Sector, which will cover businesses served by the HP sales force or dealers and distributors, and the Networked Systems Sector, which will focus on multiuser customers. "This new organization gives us a cleaner and simpler alignment of business," says Dean C. Morton, HP executive vice president and chief operating officer. In August, he was named to direct the company's computer activities. The two new sectors, as well as the Marketing and International Sector, all now report to Morton.

A GOOD YEAR FOR PC SOFTWARE

Companies selling software for personal computers may be forgiven if they would like 1988 to last forever. For the first nine months of the year, their sales have risen 48%, says the Software Publishers Association. That comes to a total of $2.83 billion in the four major PC software-applications markets: recreation, education, productivity, and languages/utilities. In the third quarter alone, says the association, the increase was 42%, to $1.01 billion.

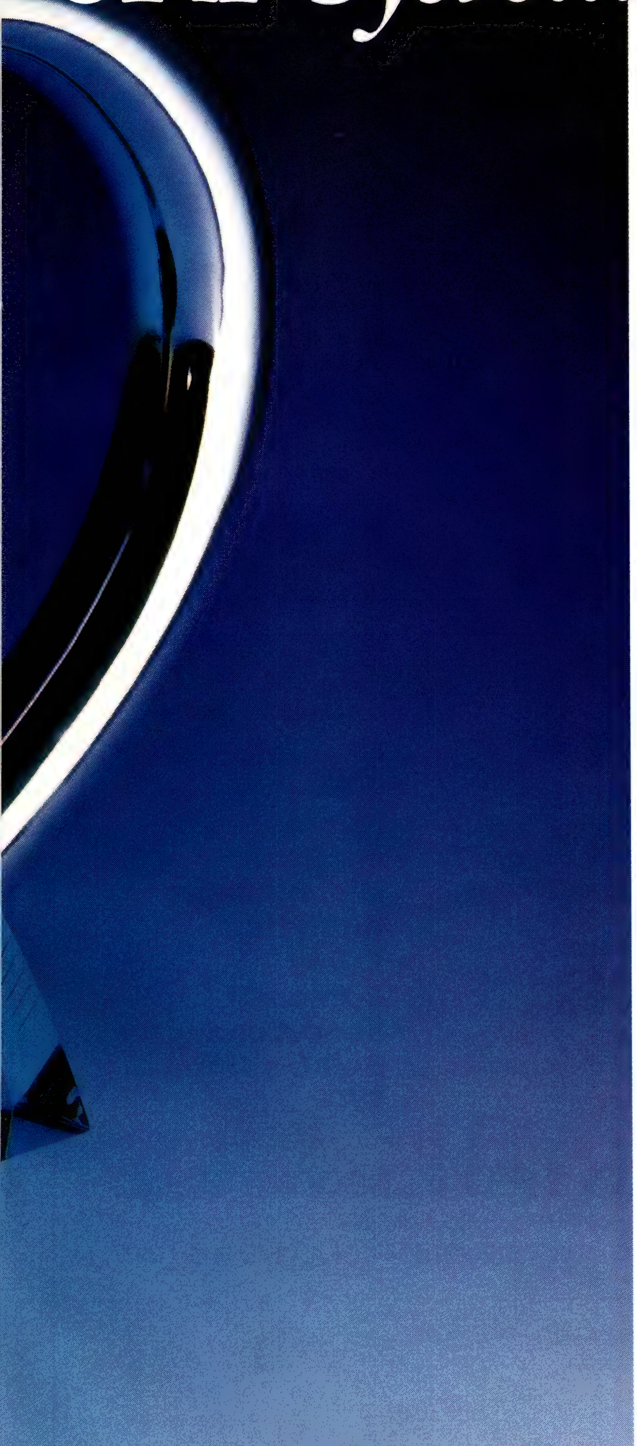
SQUARE D CELEBRATES ITS 85TH BIRTHDAY

It started in 1903 in a Detroit plant that made cartridge-type electrical fuses, and now Square D Co. of Palatine, Ill., is celebrating its 85th birthday at 80 facilities in 19 countries. The company, which posted $1.5 billion in sales in 1987, has recorded earnings for 55 years in a row. It turns out a long list of electrical products, as well as electronic systems, materials, and components, with the electronic side of the business accounting for approximately 18% of its sales.

SONY SETS UP A U. S. OPTICAL GROUP

Sony Corp. of America has combined two of its existing product lines to form an optical storage systems division. With headquarters in Park Ridge, N. J., it will coordinate Sony's American optical-storage peripherals and systems operations, and compact disk read-only memory work. The lines that will be included are CD-ROM write-once read-many products and rewritable optical devices. The new division will be headed by M. H. Chaffin, vice president of Sony America's Advanced Technology Group.

OKI System Technologies.

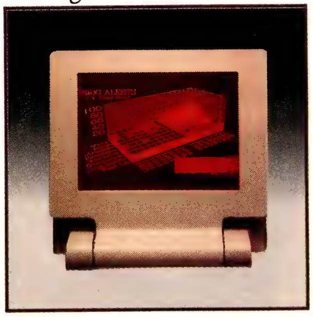


The solution is at hand, with parts, design and production assistance from OKI

Oki is ready to help you speed product development, improve your production efficiency and shave costs with integrated system technologies and constant technical support. Oki is more than a one-stop source of the highest-quality electronic devices and state-of-the-art ASIC design and production. We provide total project assistance, from design and manufacturing of system components and modules to technology assistance, available at any development stage, through design centers in the U.S., Europe, and Asia.

VGA-Compatible Monochrome Plasma Displays

Oki is the first manufacturer to offer plasma displays fully compatible with the latest industry standard controllers. A full range from MDA to 640 x 480 16-level gray scale VGA. Break through the new-applications design bottleneck with Oki system support.



Thin, lightweight with custom driver circuitry and low power consumption, Oki plasma displays are the total solution to all your specialized display needs — from portables, to space-saving desktop units, to automatic-teller machines.

Oki Electric Industry Co., Ltd.
Electronic Devices Group
Overseas Marketing Group
Head Office Annex
10-3, Shibaura, 4-chome,
Minato-ku, Tokyo 108, Japan
Tel: 3-454-2111
Fax: 3-798-7643
Telex: J22627 OKIDEN

Oki Electric Europe GmbH
Hellersbergstr. 2,
D-4040 Neuss 1,
West Germany
Tel: 2101-15960
Fax: 2101-103539
Telex: 8517427 OKI D

Oki Semiconductor Group
785 North Mary Avenue,
Sunnyvale, CA 94086, U.S.A.
Tel: 408-720-1900
Fax: 408-720-1918
Telex: 296687 OKI SUVL

Oki Electronics (Hong Kong) Ltd.
16th Floor, Fairmont House,
8 Cotton Tree Drive, Hong Kong
Tel: 5-263111
Fax: 5-200102
Telex: 62459 OKIHK HX

OKI
ELECTRONIC DEVICES

Circle 141

OKI

Oki Electric Industry Co., Ltd.
Tokyo, Japan

NEED INSIGHT? NOT WITH 'GAINING GROUND'

GAINING GROUND: JAPAN'S STRIDES IN SCIENCE & TECHNOLOGY
by George Gamota & Wendy Frieman
Cambridge, Mass.: Ballinger Publishing Co., $32.00

The enormous gains made by Japanese industry since the end of World War II have created at least one thriving business in the U. S.—exploring and explaining the enormous strides taken by Japanese industry since the end of World War II. *Gaining Ground* is the latest model off the assembly line, and it does for economic analysis and technological reporting about what the Ford Pinto did for automotive design.

The book originated as a series of reports compiled by something called JTECH, a project in which panels of "experts" study what Japan is doing in various areas of science and technology. The project was commissioned and is funded by the federal government. The results are pretty much what you would expect from a group of consultants who keep busy by working for a bunch of bureaucrats. The glaringly obvious is mercilessly discussed at tedious length.

An introductory first chapter is largely given over to explaining what JTECH is and how it works. The second chapter briefly outlines some of the differences in Japanese government, university, and industrial structures. Six more chapters make up the bulk of the book, each devoted to a specific area of science or technology: computer science, opto- and microelectronics, advanced polymers, mechatronics, telecommunications, and biotechnology. These chapters are supposed to examine what the Japanese are doing in each area.

"Examine," however, overstates the case. For the most part, a specific field within, say, computer science, gets one paragraph that describes Japanese efforts in the blandest possible terms. An example, taken pretty much at random, is this passage concerning parallel-processing architectures:

> *In the realm of parallel architectures, a wide variety of research has been reported. Japan has generally lagged behind the United States in all areas of parallel architecture research, but it is improving significantly in advanced development. This includes development of models for parallel execution of logic programs, general scientific applications, sparse matrix problems, linear equation solving, and distributed data base applications. The university of Tokyo, for example, has developed a "parallel inference engine" for logic programming, and the University of Tsukuba has reported on research involving its PAX-128 highly parallel processor array for scientific applications.*

That's not much more than a list of some things Japanese researchers are working on. The last sentence is particularly unenlightening, and all too typical. The university has reported on certain research. What did it report? Merely that a project exists? That the project has succeeded? Failed? What would the effect be on U. S. parallel-processing research if it were to succeed or fail?

The second chapter gives some indication of the book that could have been written. It mentions three respects in which the Japanese differ from Americans in their approach to science and technology.

One is that Japanese researchers closely study the basic research papers coming out of the U. S., because for many years it was technologically far inferior to the U. S. Second is that the Japanese have tended to concentrate on applied research—on taking basic research and applying it to actual products. Finally, Japan spends relatively little on defense leaving industry free to work on commercial products.

These three points have a host of interesting implications. Not the least of these is how long Japan can keep up its pace without a solid foundation of indigenous basic research. Conversely, how long can the U. S. rely on an ad hoc structure for translating its basic research—still the best in the world—into actual products?

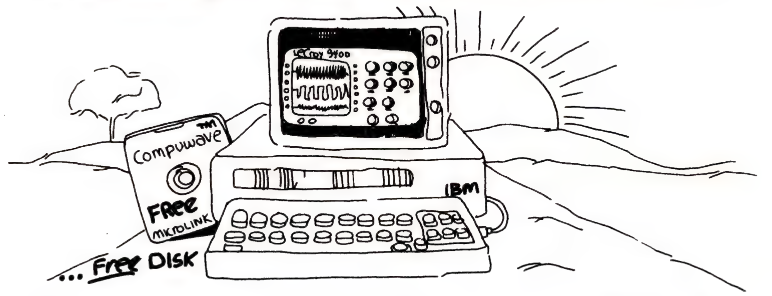
Good questions. You won't find any answers in *Gaining Ground*. You won't find any questions either. *–Larry King*

RELIABILITY PREDICTION SOFTWARE

ARE YOUR PRODUCTS RELIABLE?
RelCalc 2 automates MIL-HDBK-217E on your IBM PC!
Very easy to use. Demo package $25.

T-CUBED SYSTEMS
(818) 991-0057
31220 La Baya Drive, #110
Westlake Village, CA 91362

Now, the LeCroy 9400® DSO is coming to a PC screen near you...



COMPUWAVE™ has put all the functions of your personal computer and the LeCroy 9400* digital storage oscilloscope together at your fingertips.

COMPUWAVE™ was designed for waveform acquisition. Plus, it displays and stores waveforms for the LeCroy 9400.* Here are some of these breakthrough features:

- Choice of vector or dot mode waveform display, supporting Hercules,* CGA and EGA graphics adaptors.
- Waveform "Send" function (back to the 9400) for further waveform processing and restorage.
- Error checking and handling of GPIB bus and peripheral devices.
- Compact data storage with data and time stamps included.
- Hardcopy documentation of waveform parameters.
- High-speed "on-the-fly" data acquisition.
- Menu-driven single keystroke operation.

Hardware Requirements:
IBM PC, XT, AT or fully compatible computer.
National Instruments PCII/PCIIA IEEE-488 interface card.

Trademark/Owners:
COMPUWAVE/Microlink Inc.; LeCroy 9400 LeCroy Corporation, PCII, PCIIA/National Instruments; IBM PC, XT, AT International Business Machines, Inc.

Microlink Inc. • P.O. Box 59610
Chicago, IL 60659-0610 • (312) **854-5882**

Please call or fill out our coupon for your FREE demo kit.
• P.O. Box 59610 Chicago, IL 60659-0610

Name
Address
City
State
Zip
Phone

Microlink

Circle 143

New and Current Products
Presented by the Manufacturer

Direct Connection Ads

To Advertise call Brian Ceraolo (201) 393-6478

BINDING POSTS AND ELECTRICAL CONNECTORS

Full color, 12-page Bulletin EC779-1 has data on UL listed limited opening 5-WAY® Binding Posts with nickel, tin or gold plated brass current carrying parts, plastic parts in 6 colors; single conductor SUPERCON® Electrical Connectors in 25 to 250A plugs and receptacles with simplified, quick assembly and choice of 6 colors; and 5-WAY Test Probes for plug-in, hook-on or touch contact, available in red or black.

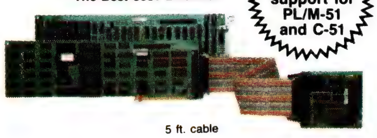
SPECIALTY PRODUCTS
Division Superior Electric
383 Middle Street
Bristol, CT 06010
(203) 582-9561 FAX: (203) 584-1483

SPECIALTY PRODUCTS **CIRCLE 500**

☆ ☆ ☆ ☆

NEW Source Level support for PL/M-51 and C-51

" The Best 8051 Emulator"



8051

See EEM 88/89 Page D-1304

PC based emulators for the 8051 family
(8051/51FA/52/31/32/44/152/451/452/535/552 + CMOS + more ...

- PC plug in boards or RS-232 box
- Pull-down menus combined with Command-Driven User Interface. Context sensitive help and On-Screen Editing of data
- 20 MHz real time emulation
- 128K emulation memory
- 48 bit wide, 16K deep trace buffer with loop counter
- Program Performance analyzer
- Powerful Macros with IF-ELSE, REPEAT-WHILE structures
- Source Level debug for PL/M-51 and C-51
- Symbolic debugging with in-line assembler and disassembler
- Execution time counter
- Trace can be viewed during emulation!

PRICES: 32K Emulator for 8031 $1790,* 4K Trace $1495*
CALL OR WRITE FOR FREE DEMO DISK!
Ask about our demo VIDEO!

*U.S. only

NOHAU CORPORATION
51 E. Campbell Avenue
Campbell, CA 95008
FAX (408) 378-7869
(408) 866-1820

NOHAU **CIRCLE 501**

PROMAC®
Programming Instruments

- Stand-Alone or PC-Based
- Engineering / Development
- Production / Field Service
- E/EE PROM / PAL / EPLD / Bipolar
- Single-Chip Microcomputers
- Simulator / Erasers / Surface-Mount

adams·macdonald
ENTERPRISES INC
800 Airport Road
Monterey, California 93940
Tel (408) 373-3607
Telex 882141
Fax (408) 373-3622
800-777-1202

PROGRAMMING INSTRUMENTS **CIRCLE 502**

PICTURE THIS . . .
YOUR AD
IN COLOR . . .

Call
Brian Ceraolo
(201) 393-6478

For all the colorful details.

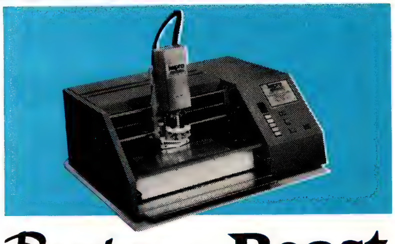
CIRCLE 505

ELECTRONIC TOOLS AND TEST EQUIPMENT

Color illustrated 195-page catalog from Specialized Products Company details an extensive selection of electronic tool kits, test equipment, telecommunications equipment and electronic production aids. Indexed catalog shows digital multimeters, breakout boxes, hand tools, soldering equipment and more - all with specifications and prices.

SPECIALIZED PRODUCTS CO., 2117 W. Walnut Hill Ln., Irving, TX 75038. Phone (800) 527-5018

CATALOG **CIRCLE 504**



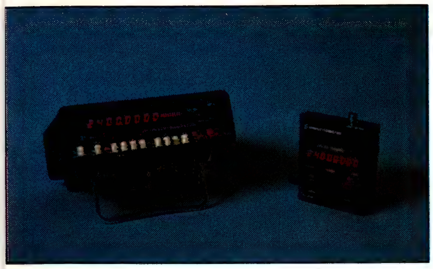
Beauty and the Beast

Mechanical fabrication of prototype and short-run PC Boards can be a beastly job. Unless you use a **Kepro Computer Numerically Controlled Drill/Router.**

The new **Kepro CNC-1218RCC6 bench-top drill/router** is the beauty that'll tame the beast. You get total mechanical fabrication with one machine, the fastest and most reliable tool change with its revolving carousel six-tool head and a host of operating benefits built-in to save labor costs. All for less than $20,000!

kepro
Kepro Circuit Systems, Inc.
1-800-325-3878
1-314-343-1630 (in Missouri)
630 Axminister Drive
Fenton, Missouri 63026-2992

BENCH-TOP DRILL-ROUTER **CIRCLE 503**



NEW!
HAND HELD AND BENCH/PORTABLE 2.4 GHz FREQUENCY COUNTERS

MODEL 2400H $299, POCKET SIZED HAND HELD 2.4 GHz 8 DIGIT FREQUENCY COUNTER WITH INTERNAL Ni-Cad BATTERIES AND 1PPM TIME BASE. RANGE IS 10 MHz TO 2.4 GHz. SENSITIVITY IS BELOW 10 MV BETWEEN 27 MHz AND 2 GHz!.

MODEL 8024-S $999, 9 DIGIT COMPACT BENCH/PORTABLE 2.4 GHz COUNTER WITH STANDARD 1 PPM TCXO TIME BASE OR OPTIONAL .1 PPM TCXO. RANGE IS 10 Hz TO OVER 2.4 GHz WITH EXCELLENT SENSITIVITY. FEATURES INCLUDE FOUR GATE TIMES, SENSITIVITY ADJUST, EXTERNAL CLOCK IN/OUT, HOLD SWITCH AND MORE.

BOTH COUNTERS HAVE ATTRACTIVE ALUMINUM ENCLOSURES AND ARE SUPPORTED WITH A FULL LINE OF ACCESSORIES INCLUDING PROBES, ANTENNAS, AND SOFT PADDED CARRY CASES. MADE IN USA. DELIVERY FROM STOCK.

CALL 800-327-5912 FOR ORDERS OR INFORMATION (IN FL CALL 305-771-2050). FAX (305) 771-2052.

OPTOELECTRONICS INC. 5821 N.E. 14th AVE. FORT LAUDERDALE, FL 33334

FREQUENCY COUNTERS **CIRCLE 515**

---

target over 30 microprocessors

CROSS ASSEMBLERS

Universal Linker, Librarian

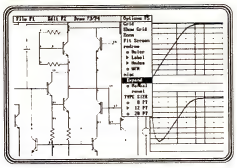
micro VAX, VAX VMS, PC/MS DOS

- Powerful macros
- Relocatable or absolute code
- Binary or ASCII Hex file output
- Fast Version 2.2
- Universal Linker for all targets
- Conditional assembly
- Prompt delivery

ENERTEC INC, 19 Jenkins Avenue
Lansdale, PA 19446 • 215-362-0966

CROSS ASSEMBLIES **CIRCLE 516**

Analog Circuit Simulation



NEW
IS_SPICE/386
$386.00

Runs on 386 PC's in protected mode with DOS 3.1 & up. Uses 287, 387 or W1167 coprocessor

- **IS_SPICE, $95.00:** Performs AC, DC and Transient analysis; runs on all 80?86 PC's in real mode.
- **PRE_SPICE, $200.00:** Adds Monte Carlo Analysis, Sweeps, Optimization, libraries and algebraic parameter evaluation .
- **Intu_Scope, $250:** A graphics post processor works like a digital oscilloscope. Easy to use with all the waveform operations you will ever need.
- **SPICE_NET, $295:** Schematic entry for any SPICE simulator. Automatically makes a SPICE net list and places Intu_Scope waveforms on your schematic.
- 30Day Money Back Guarantee

intusoft
(213) 833-0710

P.O. Box 6607
San Pedro, CA
90734-6607

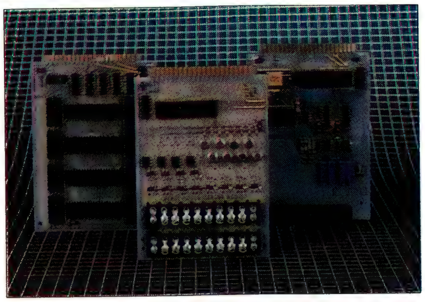
SOFTWARE **CIRCLE 517**

PCB SOFTWARE FOR THE IBM PC

With smARTWORK®, create double-sided printed-circuit boards in a fraction of the time hand taping requires. It features continual design-rule checking, automatic pad shaving, and text for all 3 layers. smARTWORK with autorouting is $895 (without, $495) and comes with a 30-day money-back guarantee. Credit cards welcome.

WINTEK CORP., 1801 South St., Lafayette, IN 47904
(800) 742-6809 or (317) 742-8428.

SOFTWARE **CIRCLE 518**

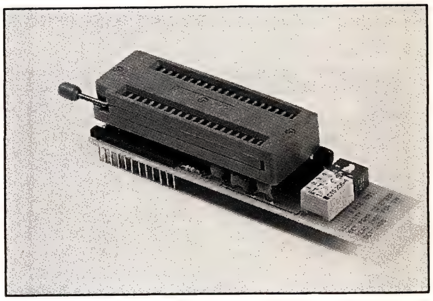


6800/6809 MICRO MODULES.

OEM 6800/6809 MICRO COMPUTER MODULES for dedicated control and monitoring. Interfaces for sensors, transducers, analog signals, solenoids, relays lamps, pumps, motors, keyboards, displays, IEEE-488, Serial I/O, floppy disks.

WINTEK CORPORATION,
1801 South Street. Lafayette, IN 47904-2993.
(317) 742-8428 or (800) 742-6809

MICRO MODULES **CIRCLE 519**



87C51 PROGRAMMER $125

The UPA87C51 converts general purpose programmers to 8751/87C51 programmers. Select 2732A on your programmer, plug in the UPA, and you have an 8751/87C51 programmer. With the UPA87C51 you can also program the 8751 and 87C51 security bits and the 87C51 encryption array. It's very simple and VERY cost effective.

Price $125.00 including UPS ground shipping. Adapters are also available for the 63701V0, 63705V0 and 8751 and are priced at $65.-$95.

LOGICAL SYSTEMS CORP. PO Box 6184, Syracuse NY 13217-6184 USA • (315) 478-0722 • Telex 6725617 LOGS FAX (315) 475-8460

87C51 PROGRAMMER **CIRCLE 520**

OPTICS CATALOG

Free 130-page catalog from largest supplier of "off-the-shelf" optics. Product descriptions, photos, data, graphs, ordering information for lenses, prisms, optical flats, reticles, mirrors, etc.

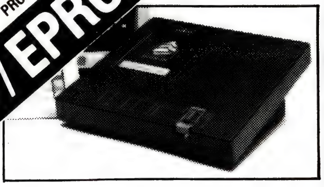
ROLYN OPTICS, 706 Arrow Grand Circle, Covina, CA. 91722-2199 (818) 915-5707

FREE CATALOG **CIRCLE 521**

SAILOR™ PROGRAMMERS

PLD/EPROM

#1 in Software
#1 in Speed



- Software driven and upgradable
- Direct control by IBM PC/XT/AT/PS2 eliminates time consuming downloading
- Automatic batch/macro file support
- Virtual memory -- requires no RAM modules even for megabit devices.

SAILOR-PAL: Universal pin drivers support PALs, GALs, PLDs, EPLDs, PEELs, ECLs, EPROMs, PROMs, FPLAs, FPLSs and MICROs. Accepts JEDEC files from CUPL, AMAZE, ABEL, etc. $1095 - $1895

SAILOR-2,-8: 2 and 8-socket set/gang high speed EPROM programmers, to Mbit devices. $545/$975

ADVIN SYSTEMS INC. Sunnyvale, CA 94086
(408) 984-8600 • FAX (408) 736-2503
Please call for free demo disk

ADVIN SYSTEMS, INC. **CIRCLE 522**

---

edi electronic devices, inc.
BRIDGES
DIODES
HV
ASSEMBLIES

Bridge Rectifiers
Axial Lead Rectifiers
High Voltage Packs
Cartridge Rectifiers
Special Devices
O.E.M. Television and CRT Rectifiers
Solid Tube Rectifiers

RECTIFER BRIDGES, DIODES AND ASSEMBLIES

Electronic Devices, Inc.'s Mini Catalog 1087 covers their lines of bridge rectifiers; high voltage axial lead diodes; high voltage packs, assemblies, and cartridges; and other rectifier devices. The rectifier bridges covered are rated to 1400 V, to 100 A, to 50 ns recovery, and are offered in many cases and mounting styles. The diodes are rated to 15,000 V, to 6 A, to 50 ns recovery, to 200°C, in many sizes. Standard assemblies can handle to 50 kV, to 25 A, to 50 ns recovery. Custom assemblies are made to order. For the catalog and free samples write to: Electronic Devices, Inc., 21 Gray Oaks Ave., Yonkers, NY 10710. (914) 965-4400.

ELECTRONIC DEVICES **CIRCLE 523**

Advertisers Index

Advertising Sales Staff

James Uhl, *Publisher;*
San Jose, CA (408) 282-7078
Tim L. Tobeck, *Director of Sales, Electronics Group;* (201) 393-6082
Hasbrouck Heights, NJ 07604

Hasbrouck Heights, NJ 07604
John R. Carroll, *Regional Advertising Director*
Robert W. Gascoigne, Judith L. Miller,
Stan Tessler
Manager of Sales Administration: Francine Guerra
Sales Support Supervisor: Betsy Tapp
Sales Coordinators: Diane Costanza,
Lorrie Grisanti
Ten Holland Dr., (201) 393-6000
TWX: 710-990-5071, (VNU BUSPUB UD)

Boston
Ric Wasley
124 Boston Post Rd.
Sudbury, MA 01776; (508) 443-0623
M.E. "Casey" McKibben, Jr.
Corporate Office Centers
585 Merrimack St.
Lowell, MA 01852 (508) 441-1224

Colorado: Ian Hill (818) 788-9178

Chicago/Midwest
Russell Gerches, George B. Mannion
Sales Assistant: Susan Johnson
707 Skokie Blvd., Suite 190
Northbrook, IL 60062 (312) 272-0919

Arizona: Chuck Crowe (818) 788-9178

Sherman Oaks, CA 91403
Thomas A. Conway, Jr., *Regional Advertising Director*
Chuck Crowe, Ian Hill, Richard Kielb
Sales Coordinator: Debi Neal
15300 Ventura Blvd. Ste. 414
(818) 788-9178

Orange County/San Diego
Richard E. Kielb
15300 Ventura Blvd., Ste. 414
Sherman Oaks, CA 91403; (818) 788-9178

Pacific Northwest: Jeffrey C. Hoopes (408) 282-7049

San Francisco
Lou Demeter (408) 282-7050
Mary Jean Davidson (408) 282-7048
Rosi Hollinbeck (408) 282-7052
Jeffrey C. Hoopes (408) 282-7049
Sales Administrator: Chery Jennings
1625 The Alameda, Suite 900
San Jose, CA 95126; (408) 282-7040

Direct Connection Ad & DAC Sales Representative:
Brian Ceraolo (201) 393-6478

Recruitment Advertising:
Helen Ryan (201) 393-6117

Eastern Canada: M.E. "Casey" McKibben, Jr.
(508) 441-1224

Western Canada: Jeffrey C. Hoopes (408) 282-7049

Austria, Belgium, Holland, Switzerland, Germany:
W.J.M. Sanders, S.I.P.A.S.
Oosterpark 6-P.O. Box 25
1483 ZG DeRyp, Holland
Phone: 02997-1303
Telex: 13039 SIPAS NL; Telefax: (02997)-1500

France: Gerard Lasfargues
32 rue Desbordes Valmore
75116 Paris, France; Phone: (1) 45 04 97 94

Italy: Luigi Rancati
20090 Segrate
Milano S. Felice Torre 5, Italy
Phone: 02-75-31-445, Telex: 311010 Orchid 2

Japan: Hirokazu Morita
Mizuno Bldg., 1-2-3,
Kanda Jimbo-cho,
Chiyoda-Ku
Tokyo 101 Japan
Phone: (03) 219-5381

Korea: O Kyu Park
World Marketing Inc.
C.P.O. Box 4010; Seoul, Korea
Phone: 776-5291-3, Telex: WLDMKG K25209

Taiwan:
Owen Wang, Ace Media Agency, Inc.
Rm. 503, 1, Fu Hsin S. Rd, Sec. 1
Taipei, 10587, Taiwan, R.O.C.
Phone: (02) 751-3636, Telex: 14142 ACEGROUP

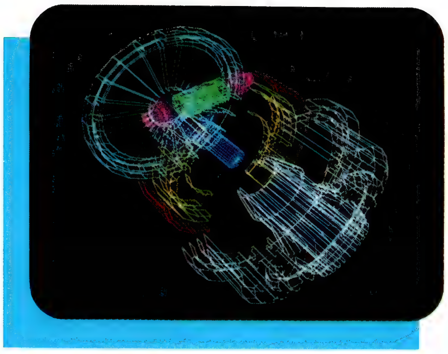
United Kingdom-Scandinavia/Israel:
Paul D. Dimmock
Intergroup Communications
286 West Barnes Lane
New Malden, Surrey KT3 6LU, England
Phone: 01-949-0354, Telex: 291561

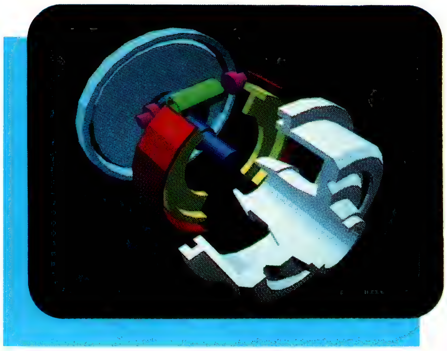
Abbott Transistors	48
Accel Technologies	146
Actel	71-78
Additive Technologies	148
Advanced Micro Devices	6-7
Avantest Corp.	16
Advin Systems	147
AMP	26-27
Amplifier Research	8
Analog Design Tools	129, 131, 133, 135
Anritsu Corp.	80-81
Basicon	146
Bertan Assoc.	142
BP Microsystems	146
****Cadence**	114-115
Capital Equipment Corp.	148
Clearpoint	39, 41, 43
Communications Specialties	146
***Cybernetics**	107
Cypress Semiconductor	44-45
Daicel Chemical	130
Data Translation	47
***Department of Texas**	56
Design Workshop	25
Electronic Devices	147
Emulation Technologies	146
Enertec	147
Entran Devices	148
****ES2**	51
Frequency Devices	128
****Fujitsu Limited**	36F-36G
***Fujitsu Microelectronics**	86-87
GE Solid State	CV2-Pg 1
Genrad Inc.	13
Glar-Ban Inc.	148
Hewlett-Packard	42, 146
IBI Systems	146
Illinois Dept. of Employment	144
****Imprimis**	86-87
Indiana Development	88
Intel Corp.	67-69, 138
****Intergraph Corp.**	56
Intusoft	147
****JAI**	360
Kepro Circuit Systems	145
Lambda Electronics	33-36
Logical Devices	146
Logical Systems	147
Matrox Electronic Systems	CV3
***Measurement Systems**	144
Mepco Centralab	59
Micro Computer Control	148
Microlink	143
Microprocessors Unlimited	148
****Microtek Int'l.**	36B
***Mosis**	107
Motorola Semiconductor	20-21
****Murata Mfg. Co.**	28
NEC Corp.	99-101
***Netherlands Foreign Investment**	51
Nohau Corp.	145
****Noise Labs**	36K
OKI Electric	140-141
Optoelectronics	147
P-Cad	9
Pearson Electronics	12
Performance Semiconductor	63, 65
Philips Components	**36L-36M, 122-123
****Philips I+E**	36E, 36P
Promac Division	145
Pro-Lib	148
Pulizzi Engineering	146
Rolyn Optics	147
****Saft**	36A
***Seiko Instruments**	28
SGS Semiconductor	14-15
Siemens AG	**36H-36I, **106-107, 136-137
Siemens Components	148
Siemens Optoelectronics	94
Signetics Corp.	22
Simpson Electric	2
Specialized Products	145
Specialty Products	145
T-Cubed Systems	143
Teledyne Relays	134
Texas Instruments	Outsert
***Toshiba America**	114-115
Toshiba Corp.	CV4
TRW LSI Products Inc.	19
Vicor Corp.	10-11
Visionics Corp.	31
VLSI Technology Inc.	52-55
Wintek Corp.	147
Zax	40

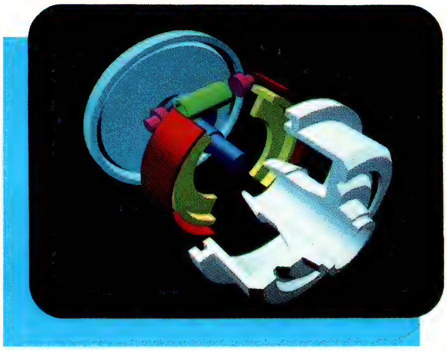
*** Domestic only**
**** International only**

The advertisers' index is prepared as an additional service. ELECTRONICS does not assume any liability for errors or omissions.

One. Two. 3D.







Draw 20,000 Gouraud-shaded polygons a second...
90,000 3D vectors a second.

Choose 256 colors from 16.7 million.

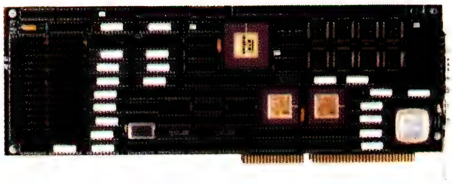
Turn a desktop PC AT into a professional 3D CAD workstation with the Matrox **SM-1281** graphics controller.

Based on the Matrox PG-1281 graphics processor for 2D workstations, the **SM-1281's** pipelined architecture has been optimized for sophisticated 3D processing. For the price of a single board, the **SM-1281** gives your PC AT the performance of high-end 3D graphics systems.

■ True workstation resolution [1280 × 1024] ■ High-level 3D primitives ■ Extensive display list capabilities ■ Hardware hidden surface removal ■ Depth cueing ■ Programmable light sources ■ Z-buffering

One, two, three. Don't wait to see.

1-800-361-4903



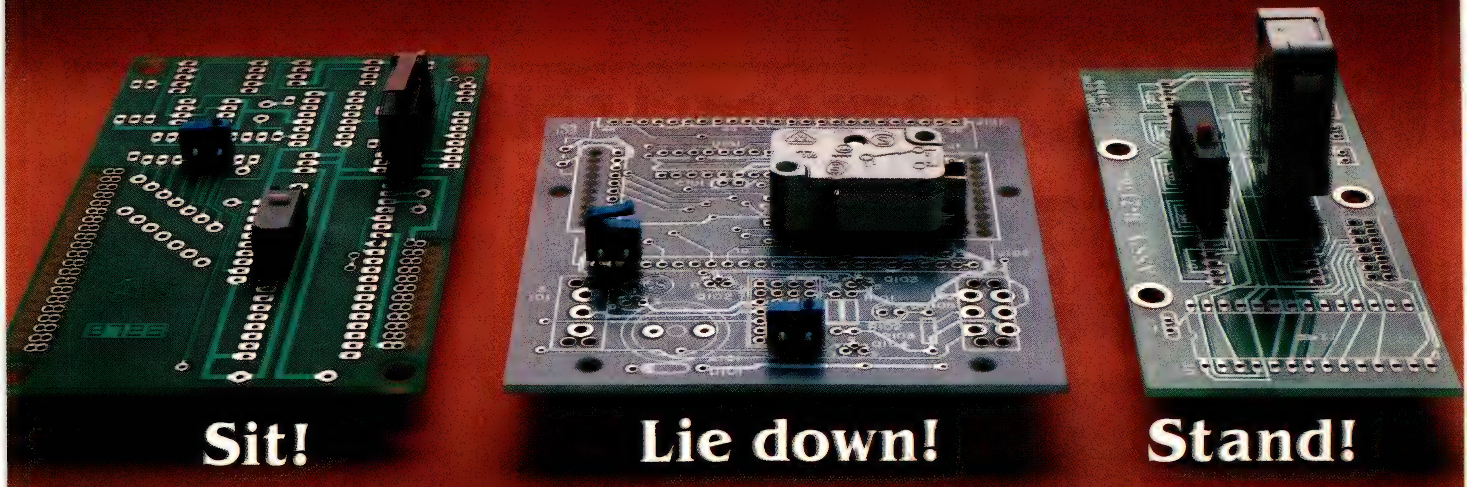
A LEADER IN VIDEO MICROTECHNOLOGY

matrox

In Canada, call (514) 685-2630. PC AT and Matrox are registered trademarks of International Business Machines Corporation and Matrox Electronic Systems Ltd. respectively.

ELEC-3D/1288

Circle 206

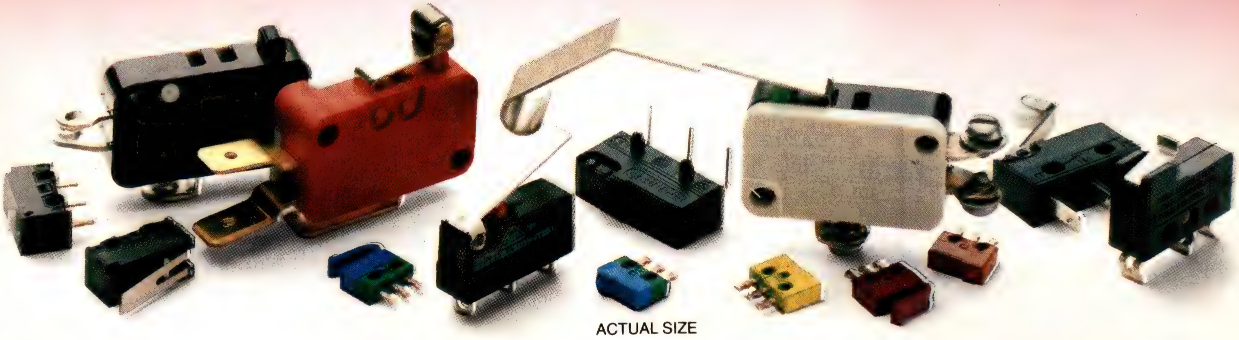


They'll do anything except roll over and play dead.

Any size, shape, type switch you want. Miniature, subminiature or sub-subminiature. Choice of terminal types: QC, solder, screw, even "dogleg." Anything from basic button to lever actuator, plus many special actuator forms. If you need it, we have it, or can make it. Just call and we'll jump.

CHERRY®

CHERRY ELECTRICAL PRODUCTS
3600 Sunset Avenue, Waukegan, IL 60087 • TEL: (312) 360-3500 • FAX: (312) 360-3566
Switches • Automotive Devices • Electronic Components • Displays • Printed Circuit Boards • ICs • Keyboards



Circle 13 on reader service card

See us at WESCON/San Francisco, Nov. 17-19, 1987, CHERRY BOOTH #517

PHILIPS

Tailor your own system set-up!

TEST & MEASUREMENT - INSTRUMENTATION SYSTEMS

Philips **System 21** - a highly flexible modular system for automatic test and measurement providing versatile I/O and switching functions controlled via the GPIB.

So you can get easily configure - and reconfigure - your own small to medium-sized GPIB instrumentation set-up.

Simply and economically. Occupying only a single GPIB bus address, **System 21** comprises a master GPIB interface/power supply module, and a range of slave modules for: switching (up tot 18GHz); digital I/O; A/D conversion, and a user-adaptable module for customized functions.

And our commitment to hard- and software development ensures that **System 21** will continue to grow up without ever growing old!

Product Credibilty in technology, technique, quality and service, too, is assured because **System 21** is backed by the resources of one of the world's largest electronics companies.

MADE TO MEASURE

Write to: Philips I&E, T&M department, Building HKF70, 5600 MD Eindhoven, The Netherlands or call your local supplier: **Austria** (222) 629 141; **Belgium** (2) 5256692/94; **Denmark** (1) 572222; **Finland** (0) 5257225; **France** (1) 49428000; **Germany** (561) 5010; **Great Britain** (0223) 358866; **Ireland** (1) 693355; **Italy** (39) 3635 240/8/9; **Netherlands** (40) 782808; **Norway** (2) 680200; **Portugal** (1) 683121; **Spain** (1) 4042200; **Sweden** (8) 7821800; **Switzerland** (1) 4882211.

Advanced technology made to measure

ASSESSING THE FUTURE OF ELECTRONICS MARKETS AND TECHNOLOGIES.

A special three-part series from the editors of *Electronics* magazine.

1. COMING DECEMBER 17: EXECUTIVE OUTLOOK DOUBLE ISSUE

Special Report: A View From The Top
This report reveals the opinions of a cross section of Presidents, CEOs, and other business executives on a variety of important issues. Like what technology developments they see affecting their business the most during the coming year. What they believe will be the greatest obstacles to their company's growth in 1988. And how foreign competition is changing their overall marketing strategy.

Special Report: Technologists' Outlook
In this report, technical managers and senior engineers from leading companies around the world express their viewpoints on a host of technology issues. Their perceptions of the pace of technology change. What they believe will be the next technology driver. And what the major stumbling blocks are in getting new products to market.

Also in this issue...
A Major Editorial Package On New Linear Technologies
Linear-circuit designers are being pushed into the VLSI era. We'll examine what analog technology makers are doing to keep pace with digital circuits in easing systems bottlenecks. And provide a comprehensive package of technologies to watch from some of the industry's major players.

And A Preview Of ISSCC And IEDM
Each year, ISSCC and IEDM are the premier forums for advances pushing the state-of-the-art in circuit-level and board-level devices. We'll preview expected developments in areas including SRAMs, DRAMs, EPROMs, EEPROMs, and RISC.

Advertising Closing Date: November 23
Recruitment Closing Date: November 30

2. COMING JANUARY 7: U.S. MARKET FORECAST

The industry's only staff-written market forecast, this annual issue examines the consumption of electronics and computer equipment in eight industry segments. More than 400 specialized categories will be charted, with estimates for 1987 business and forecasts for 1988.

Also in this issue...

- **Technology Series On Analog And Power**
- **Annual Advertiser Contest**
- **Postcom Readership Survey**

Advertising Closing Date: December 14
Recruitment Closing Date: December 21

3. COMING JANUARY 21: OVERSEAS MARKET FORECAST

Similar to the U.S. Market Forecast, this special report focuses on what marketing managers from leading companies in Japan, the United Kingdom, France, West Germany, and Italy foresee in the coming year for their electronics and computer product lines. What technologies are being targeted for investment. And where demand will be strongest in 1988.

Advertising Closing Date: December 28
Recruitment Closing Date: January 4

McGraw-Hill **Electronics**

ELECTRONICS NEWSLETTER

TRADE SANCTIONS SEEM TO BE CUTTING JAPAN'S SHARE OF CHIP MARKET

Trade sanctions imposed by the U. S. last April helped stop Japan from dumping chips and cut into its share of the world chip market last summer, says Michael A. Gumport, an analyst with Drexel Burnham Lambert Inc. in New York. Even so, it took the Reagan Administration until early November to ease the punitive sanctions. Japan's share of the world merchant chip market slipped in August to 52.1% of a total $2.6 billion market, from 53.7% of $2.7 billion in July, Gumport says. In the U. S., Japan's share dropped from 14.9% in July—which was good for $126.6 million in sales—to just 13.7%, or $120.3 million, in August. Gumport notes that if price wars resume, the tariffs on certain Japanese color TVs, computers, and power tools could be reinstated quickly. Not all the sanctions are being lifted, though. Some will remain in effect until Japan opens its market to U. S.-made chips.☐

INTEL OFFERS A PEEK AT THE FUTURE: THE MAINFRAME-ON-A-CHIP

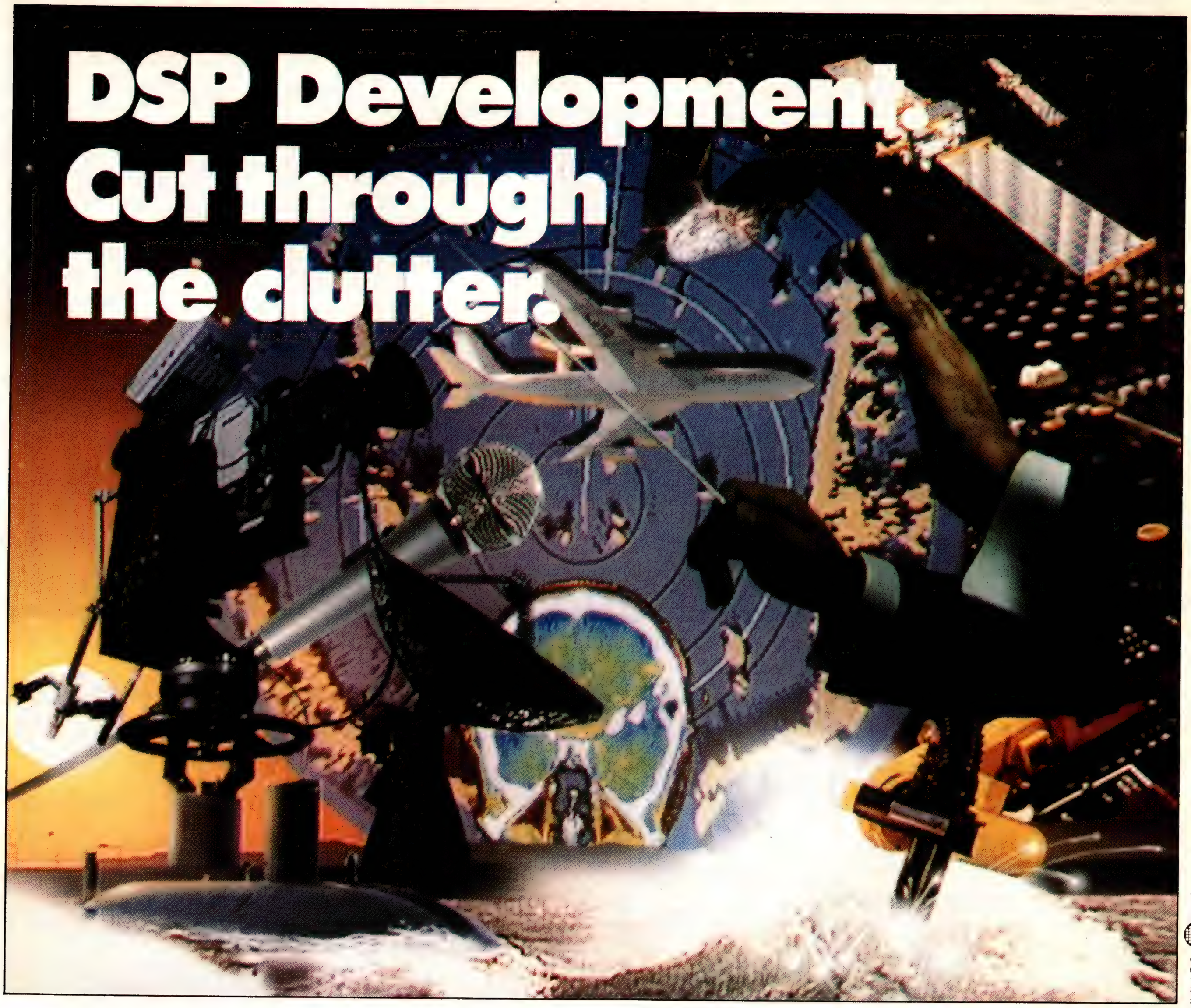
IBM wasn't the only one trying to create a bandwagon effect at Comdex (see p. 31). Intel Corp. "opened up the kimono" on what will become the successor to its 32-bit 80386 microprocessor. Perhaps to be called the 486, it will be announced sometime in 1989. The million-transistor chip will be fully compatible with the 386, says Dave House, Intel senior vice president. He estimates that mainframe-class machines built around the new microprocessor would be available commercially in 1990. "Between now and 1990, we'll be introducing silicon for every segment of computer product," House said. In his ongoing battle with Motorola over 32-bit microprocessor leadership, he told a Comdex audience the 386 has now chalked up more than 400 design wins. Claiming that Intel is already outshipping Motorola, company managers say they'll be disappointed if they don't ship 2 million 386s next year. ☐

MOTOROLA AND NATIONAL END FEUD, TEAM UP ON FACT LOGIC

The falling out between Motorola Inc. and National Semiconductor Corp. over an ill-fated 1982 gate-array alliance has finally ended and the two chip makers are announcing a major alternate-sourcing pact. The three-year deal will cover 108 advanced CMOS logic components. National and Motorola will take on National's advanced CMOS process (FACT) in three phases. The first 30 designs are now being given to Motorola. Data is being exchanged to assure CMOS compatibility, but no process technology is being traded. In phase 2, National will give Motorola 16 more devices early next year. In return, Motorola will help speed National's introduction of 22 FACT logic parts by completing device characterization and qualification work. In the final phase, the companies will share 40 new FACT designs in 1989. ☐

AMD AND READY SYSTEMS POINT THE 29000 AT EMBEDDED CONTROL

Advanced Micro Devices Inc. is trying to stake out an early claim in the virgin 32-bit microcontroller market by aiming its Am29000 reduced-instruction-set microprocessor at real-time embedded control. AMD and Ready Systems Corp. of Palo Alto, Calif., have entered into a joint-technology pact to produce a real-time operating system for the RISC chip, which boasts peak performance of 25 million instructions/s [*Electronics,* March 19, 1987, p. 61]. To adapt its VRTX32 operating system to the 29000, Ready Systems plans to add more than 30 directives, enabling the RISC processor to run functions required in such real-time embedded control applications as industrial robotics, communications, and weapons systems. In addition to creating a 29000 version of VRTX32, Ready Systems will provide versions of a multitasking debugger, called RTscope, and a system monitor for the processor. ☐


DSP Development.
Cut through
the clutter.

INMOS and IMS are trademarks of the INMOS Group of Companies.

You've seen the advantages offered by the A100 Digital Signal Processor. The single-chip DSP solution that features 32 multiply-accumulators, executes up to 320 MOPs, and easily attaches to microprocessors.

Now INMOS speeds A100 system development with the new D704, the complete DSP Development System. The D704 overcomes the clutter normally encountered in developing DSP systems such as hand-crafted assemblers, interleaved busses and power-hungry glue. And since it is tailored for the A100, your end product is first to market and second-to-none in performance.

The D704 combines a comprehensive set of software tools, PC plug-in card and extensive documentation, providing a powerful yet easy-to-use DSP environment. You can experiment with the technology, simulate DSP algorithms in software and run them in real time on the A100's provided on the board.

The A100 is quickly becoming the number one choice in everything from avionics to ultrasonics. And with MIL-STD 883C devices available soon, it will be a natural for military DSP programs of all types. With the D704 Development System, creating DSP solutions has never been easier.

So if you'd like to cut through the clutter, start by clipping the coupon.

THE A100 DSP FAMILY

IMS A100	Single-Chip 32-Stage Cascadable Transversal Filter— 16-Bit Data, 16-Bit Coefficients, 320 MOPs
IMS B009	PC Plug-In Card Including Four A100's
IMS D704	IMS B009 + Interactive Software Simulator/ DSP Development Suite

inmos®

I'd like to cut through the clutter. Please send me full details of the IMS D704 DSP development system.

Name ______________________ Title __________

Company ______________________

Address ______________________

Telephone ______________________

E 11/12

INMOS Corporation, PO Box 16000, Colorado Springs, Colorado 80935.
Tel (303) 630-4000.

INMOS Limited, PO Box 424, Bristol BS99 7DD. Tel (0454) 616616.

Circle 23 on reader service card

PRODUCTS NEWSLETTER

NEC'S 2-MBIT EPROM PROGRAMS 72 TIMES FASTER PER BIT

The tedious process of programming large ultraviolet-erasable programmable read-only memories will be speeded up considerably with NEC Corp.'s 2-Mbit EPROM. It can be programmed in just 10 seconds—72 times per bit faster than using 256-Kbit EPROMs that each take 90 seconds. Chip designers turned the trick with a method that simultaneously programs 4 bytes with each 0.1-ms, 12.5-V pulse. Fabricated in 1.2 μm design rules, the 7-by-10.48-mm μpD27C2001D boasts 150-ns access times—fast for a device its size. Operating current is 30 mA maximum at 6.7 MHz and 100 μA maximum standby. Operating voltage for the 32-pin ceramic dual in-line package is 5 V. The Tokyo-based company is now offering samples of the device priced at about $70, with production slated for March 1988. ☐

IDT BOOSTS SPEED 75% IN ITS 16-BY-16-BIT MULTIPLIERS

High-speed applications in radar, digital filtering, and fast Fourier transforms could open up for 16-by-16-bit parallel multipliers, now that Integrated Device Technology Inc. has built a 75% speed improvement into its multiplier family, already a performance leader. Its 1.2-μm logic-oriented process has spawned the IDT7216 and 7217, both boasting 20-ns multiplication times, compared with the 35-ns speed of their predecessors. The Santa Clara, Calif., company's CMOS multipliers consume 120-mA, one-tenth the power of compatible bipolar parts. The 7216 is pin-compatible with the MPY016H/K from TRW Inc., Redondo Beach, Calif., and the Am29516 from Advanced Micro Devices Inc., Sunnyvale, Calif. The 7217 requires a single clock with a register to be compatible with AMD's bipolar 29517. In 100-piece lots, the multipliers sell for $145 each in plastic 64-pin dual in-line packages. Samples are available now. Volume shipments will begin in the first quarter of 1988. ☐

HIGH-END GRAPHICS SUBSYSTEM COSTS 40% LESS THAN COMPETITION

System integrators can grab about a 40% cost savings with a graphics subsystem from Metheus Corp. that delivers 1,024-by-768-pixel resolution and a 10-million-pixels/s drawing rate for $2,495—performance now available only in systems costing $4,000. At the unit's heart is the Hillsboro, Ore., company's UGA 1104 graphics coprocessor board [*Electronics,* Oct. 1, 1987, p. 98]. In addition to its speed and resolution, the 1104 handles four bit planes and supports interlaced scan rates of 40 Hz, and noninterlaced scan rates of 60 Hz. Packaged with the card are a Sony Corp. of America 13-in. color monitor, diagnostic software, and drivers for computer-aided-design applications. The Ultra Graphics Video Subsystem is available now. ☐

AUTOMATION CONTROLLER COMBINES MULTITASKING POWER AND MS-DOS

Automation engineers can now take advantage of the vast software library written for IBM Corp. Personal Computers and compatibles, thanks to Square D Co.'s Sy/Gate Minicell controller. At the same time, they can harness the power of a proprietary multitasking operating system that addresses up to 1.5 Mbytes of memory compared with MS-DOS's 640 Kbytes. Based on an Intel Corp. 80286 processor and 80287 math coprocessor, the MiniCell boots up on MS-DOS but also runs a proprietary operating system that boasts an integrated set of functions for cell-control applications such as communication with factory peripherals and report generation. Industrialized IBM PC AT systems typically require a fan for cooling, but the MiniCell runs without a fan. That contributes to its 14-by-6.25-by-6.5-in. cabinet size—one-fifth that of comparable products. Equipped with 1.5 Mbytes of random-access memory, the MiniCell will be available by year's end for $14,995. ☐

Chip, Chip, Array!

For High Speed with Low Power.

AMCC has the chips worth cheering about. When you need the versatility of high speed with low power in a bipolar array, our Q5000 Series Logic Arrays are the answer. They're designed for logic applications requiring speed/power efficiency. And they deliver.

Today's hi-rel commercial and military semicustom applications need high performance and proven reliability. And, our Q5000 Series gives you both—without paying the power penalty.

Our newest bipolar series is comprised of five arrays. All feature 4 levels of speed/power programmable macros and over 600 MHz I/O capability. One comes with 1280 bits of configurable RAM.

Q5000 Series Key Features	
Equivalent Gate Delay:	210–545ps
Flip/Flop Frequency:	>600 MHz
Power Per Gate:	1mW
Speed/Power Product:	0.5pj
Equivalent Gates:	1300–5000
I/O Pads:	76–160
Operating Temperature Range:	−55°C to +125°C

AMCC Bipolar Logic Arrays have been designed with other flexible performance features in mind, too. Mixed ECL/TTL I/O compatibility. Your choice of packaging. Full military screening. AMCC's MacroMatrix® design tools. And, unrivaled customer support.

To talk with an applications engineer about your specific needs, in the U.S., **call toll free (800) 262-8830.** In Europe, call AMCC (U.K.) 44-256-468186. Or write, Applied MicroCircuits Corporation, 6195 Lusk Blvd., San Diego, CA 92121. (619) 450-9333.

A Better Bipolar Array is Here.

AMCC

Circle 27 on reader service card

PHILIPS

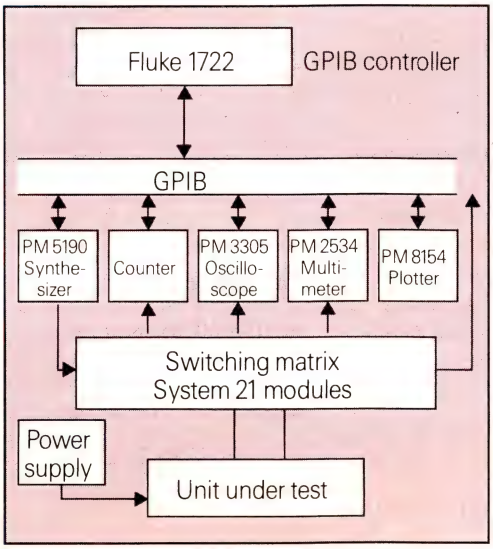
Universal System Testing

Problem. A major order for high performance, high precision DCCTs (Direct Current – Current Transformer) called for 100% functional checking of each PCB-based unit. However, the test and measurement set-up should not become redundant once the order had been completed.

Analysis. Essentially, the DCCT is a 600A to 65kA pulsatory current meter with a accuracy of +/– 5ppm. The order (575 units) was for current control of the LEP (Large Electron Positron) at the European Laboratory of Particle Physics, CERN, in Geneva.

Our customer, Holec – one of the world's leading manufacturers of computerized control equipment for high energy applications, developed a CAT (Computer Aided Testing) system in which a hierarchal instrument controller communicates with a lower-level measurement sub-system via a GPIB-interface. Measurement protocols stored in the controller provide a library of selectable measurement cycles.

Action. Using instruments from its comprehensive Test & Measurement programme, Philips configured the lower-level sub-system with: a **PM 5190** synthesizer; a **PM 3305** DSO with **PM 8154** plotter; a **PM 2534** DMM; and a switching matrix comprising 18 **System 21** modules (12 universal switches, 2 coaxial switches, 2 user adapter units and 2 master units).



Evaluation. Holec's CAT-system can now perform up to 112 measurements per cycle. Each of 32 measurement points on the PCB under test are accessible for 3 instruments. It also has 16 channels available for random measurements.
And being a fully automated test routine, once the PCB is connected to the CAT system all measurements are performed qualitively, quantitively and economically.

Most important, when the sub-system is no longer needed for PCB testing, it can easily be reconfigured for other test purposes.

MADE TO MEASURE

One of the world's largest electronics companies, Philips is both a major manufacturer and user of an extremely broad range of test and measurement instrumentation. Thus we are uniquely qualified to develop cost-effective solutions that meet your system needs, perfectly.

For further details call your local Philips office or write to:
Philips I&E, T&M department, Building HKF70, 5600 MD Eindhoven, The Netherlands; **Austria** (222) 629 141; **Belgium** (2) 5256692/94; **Denmark** (1) 572222; **Finland** (0) 5257225; **France** (1) 49428000; **Germany** (561) 5010; **Great Britain** (0223) 358866; **Ireland** (1) 693355; **Italy** (39) 3635 240/8/9; **Netherlands** (40) 782808; **Norway** (2) 680200; **Portugal** (1) 683121; **Spain** (1) 4042200; **Sweden** (8) 7821800; **Switzerland** (1) 4882211.

Advanced technology made to measure

Electronics

AT COMDEX: PC MAKERS FIGHT HARD TO UPSTAGE IBM

SO IBM GOES ALL OUT TO CREATE A PS/2 'BANDWAGON'

LAS VEGAS

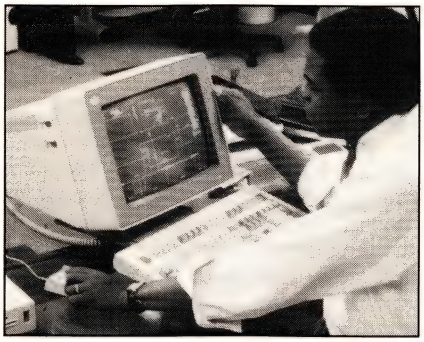
An outpouring of personal computers built around Intel's 80386 microprocessor showed up at last week's Comdex to challenge IBM Corp.'s PS/2 line and its Micro Channel bus architecture. With at least 40 exhibitors showing these new 32-bit machines, IBM Corp. fought back by attempting to create a PS/2 bandwagon. Challenges to Micro Channel from PC-compatible makers and other suppliers had already reached the flash point and IBM uncharacteristically decided to counter them by reporting PS/2 shipping rates, detailing growing software support, and speeding up the delivery of vital operating systems needed to make PS/2 work.

"It is our intention to have the industry move to the PS/2 [standards]," vowed William Lowe, president of the Entry Systems Division, at a hastily called meeting of dealers at the Las Vegas show. Leaving no doubt that the PS/2 and Micro Channel represent IBM's entire thrust in personal computers [*Electronics,* April 18, 1987, p. 46], Lowe slammed the door on any possibilities that the company would return to earlier open standards. IBM also announced that OS/2 software, believed to be behind schedule, would instead be brought out Dec. 4, about four months earlier than planned. However, that is less than meets the eye, because a crucial part of the system, the Windows Presentation Manager, won't be ready until the end of 1988.

VITAL ISSUE. But it is the issue of Micro Channel that is vital to compatible-PC makers since the architecture, unlike that of the original PC, is protected by patents—among them one that IBM acquired from Computer Automation Inc., which developed it in 1974 for minicomputers. That patent position becomes, in the view of most observers, the prime means by which IBM can restrict outsiders from copying the PS/2.

The company says an upgraded bus like Micro Channel is needed for the 80386-based PS/2 computers since it is faster and more reliable than the AT bus and can efficiently accommodate multiple intelligent processors for peripheral control and other tasks. Nevertheless, of the million PS/2 units shipped so far, only 350,000 have been equipped with Micro Channel—and few of them have been the top-of-the-line Model 80s.

The result has been that since April, Big Blue has sown confusion about its intentions with Micro Channel by saying nothing. Competitors, and a vast array of board and chip suppliers, have had to strike out on their own, without any solid guidelines from the company that has set PC standards. While this guarantees a fast hardware start in getting PS/2-like computer hardware to market, the risk is that a decisive move by IBM to impose the Micro Channel as a standard could put many competitors out on a shaky limb with incompatible clone hardware.



THE BIG QUESTION AT COMDEX: JUST HOW SUCCESSFUL IS THE PS/2? Even as IBM moved at Comdex to head off challengers in its drive to make the PS/2 an industry standard, a big question at the show was, can it be called a success? IBM was quick to ballyhoo that it has shipped 1 million PS/2s—only a third of them with the Micro Channel architecture—with the OS/2 operating system not shipping until December. The answer: not yet.

The confusion became a central issue at Comdex. "We're still unsure of the details or implications of Micro Channel," says Enzo Torresi, senior vice president for product and strategic planning at Businessland Inc. in San Jose, Calif. He chaired a panel of IBM-watchers who discussed the topic.

The panel couldn't agree on when or even if IBM would license Micro Channel. IBM is "dragging its feet" on licensing its utility patents—"the most they'll license," says William F. Zachman, vice president of International Data Corp., Framingham, Mass. IBM will license other firms if it doesn't sell enough of its own Micro Channel products to make it the standard, he maintains. "If IBM doesn't want Micro Channel to be cloned, it will not get built," he says. "IBM will sue their pants off."

Esther Dyson, newsletter publisher and software guru, disagreed. She says IBM will license "sooner rather than later because they realize this is the way to build the market." But the panelists did agree that it will take other computer makers at least a year to come up with Micro Channel clones and that these products would show up at next fall's Comdex.

But there is no question about the market potential. The worldwide market in 1987 for personal computers and related equipment will come to some $35 billion, of which IBM sells about $7 billion. That opportunity has computer suppliers rushing to fill the market, and at Comdex they were in their glory. Judging from Comdex, the Intel 80386 is the microprocessor of choice, as nearly 40 new PCs based on the fast chip were shown. Among them:

- AST Research Inc., Irvine, Calif., demonstrated its Premium/386 that runs at 20 MHz and uses a proprietary Smartslot architecture that the company says provides the same multiprocessor functionality as Micro Channel. It is actually an extension of the AT bus, so it is compatible with existing software. Shipments start this month.
- Compaq Computer Corp., Houston, offers the Deskpro 386/20 with 20-MHz speed and an optional coprocessor board that boosts it to engineering work-station status. Compaq believes Micro

parts. In 1985, it introduced its first advanced CMOS logic with a distributed transistor structure for edge-rate control. VTC's approach distributes current spikes from output drivers over time, softening the effect. It splits what would be one large pull-down transistor into two devices separated by a resistor. It is pursuing the approach for still lower ground bounce, says Jeff Hutton, product line manager for advanced CMOS logic. National Semiconductor plans to use a similar technique to upgrade the old Fairchild FACT line.

GE Solid State is following a different path. Changes in layout helped ease its noise-spike problem, says Alan Kalish, product marketing coordinator. "We changed the lead frame to increase the current path on the ground plane, also to reduce the ground bounce," he says, adding that "we used special bonding techniques to connect the die to the lead frames both mechanically and electrically." The improvements enable GE to forgo the multiple-transistor ground-edge controls. *–J. Robert Lineback*

IC PRODUCTION

A NEW LOW-COST WAY TO FIND IC FAULTS

STUTTGART, WEST GERMANY

A low-cost technique based on microthermography, now being used by Standard Electrik Lorenz AG in Stuttgart, pinpoints faults in integrated circuits with accuracy within 1 μm. To implement it, all that's needed is standard equipment found in any IC development or quality-control lab: a microscope, power supply, monitor, and a few chemical substances.

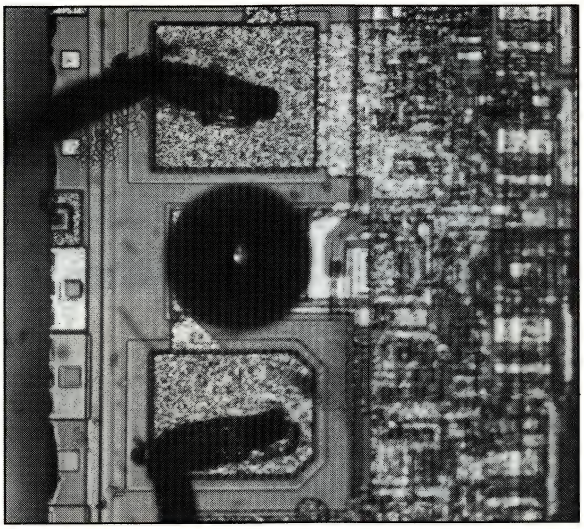
The principle underlying the technique used by SEL is simple: an IC's encapsulation is removed from the chip surface, which is then covered with a thin film of liquid and fed with an overcurrent. The area of excessive power dissipation—the location of the fault—is indicated by tiny bubbles that form and evaporate just like water drops on a hot electric plate. This phenomenon is what gives the technique its name: bubble thermography.

Chip failures can be caused by latchups, electrostatic or electrical overstress, or leakage currents resulting from crystal defects. To analyze these faults—which become evident as shorts, or parasitic resistance—some extra power can be applied to the defective circuit, producing overheating in the faulty area. The point at which the temperature is too high, or above normal values, can then be detected by several microthermographic methods, including SEL's approach.

SEL's bubble technique, however, besides sporting a 1-μm resolution, is also inexpensive, since it needs no equipment beyond what's already on hand in any lab, says Günter Eckart, head of the company's Technology and Failure Analysis group. What's more, he says, it's fast. It takes less than an hour to prepare the circuit, set up the equipment, and search the chip under a microscope for the telltale bubbles.

The first step is to lay the chip surface bare either by mechanical or chemical means—ceramic encapsulated types by milling and plastic versions by jet-etching with sulfuric acid or by applying nitric acid. But the work must be done carefully to prevent structural damage influencing the chip's electrical function, Eckart notes.

Next, a thin organic-detection medium, a liquid, is sprayed onto the chip. Acetone, propanol, or any kind of alcohol with a low boiling point can be used, but it must have a well-defined boiling point and be nontoxic, nonconducting, and clear, so that the chip structures are not obscured when viewed through the microscope. In the high-temperature area, the medium forms a bubble that is initially about 10 μm in diameter. The diameter of the bubble shrinks as the thickness of the liquid medium decreases (as a result of evaporation) until the bubble bursts. In the middle of a bubble is a bright spot that results from light not being diffracted at that point. It is this spot that pinpoints the fault on the chip to within 1 μm.



DAMNED SPOT. The dark bubble (between the contact pads) covers the area of the failure. The white dot pinpoints the fault.

The SEL process is not the only way to locate the problem area. There are other detection methods. One is infrared microthermography, where the spot of elevated temperature can be identified because the IR wavelength is different from normal. On a display, this would mean different colors. But that method can pinpoint a fault with a resolution of only about 15 μm. It is also time-consuming and calls for much special equipment.

Even more special hardware is needed in another method, liquid-crystal microthermography. In this technique, the higher temperature of the faulty area causes a change of polarization of a liquid-crystal film on the chip surface. Although the resolution is high, the analysis takes some time to perform. *–John Gosch*

MEMORIES

HERE COME THE 32-BIT FAST-CACHE MEMORIES

DALLAS

It's difficult to think of a chip market in which silicon merchants have taken so many different technological approaches as they have in the fast-cache memory business. In their zeal to help fast 32-bit microprocessors cope with the lagging access speeds of random-access memories, they are racing off on widely varying paths.

The result is expected to be a deluge of parts as microprocessors press beyond 30 MHz. Most of the niche-seeking static-RAM houses are reaching into their bags of design tricks to shave off nanoseconds and to avoid the use of costly new sub-micrometer CMOS. But at least one SRAM supplier—Performance Semiconductor Corp.—plans to match fast microprocessors with finer CMOS geometries.

"Before, cache was needed only at the high end of computer markets and in only a couple of application areas," says

On October 5th, Fluke and Philips joined forces in a global alliance for test and measurement equipment. That means Fluke now sells and services Philips products in North America. With the same customer-driven support that Fluke has delivered for over 40 years. Call us. Because now there's a competitive alternative to HP and Tek. And that's a turn for the better. For you. Phone 1-800-426-0361 Ext. 77.

FLUKE®

Ad No. 1077/CORP © Copyright 1987, Fluke

There ought to be a better way to test bus-structured boards.

FUNCTION
INPUT
"ACME SUPER" DELUXE MEGA FUNCTIONAL TESTAMATIC
BOSTON MASS.
INSTRUCTION

"Sure, sure... no problem, we'll have this baby up and running any day now... yep, just a few more days now... coming right along... heck of a tester... just a few more days more or less... yep, sure... no problem..."

Installing and programming some new testers can be almost comical.

Unless of course, it's *your* tester.

Fortunately, the Zehntel 3200 shrinks installation and programming time from months to *weeks*.

What's more, the Zehntel 3200 can test the full range of bus-structured boards. Even with multiple microprocessors.

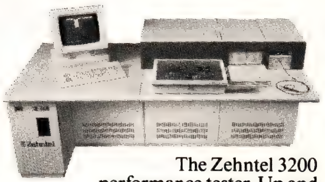
The Zehntel 3200 has diagnostics that track faults right to the root cause of failure—normally, in less than 3 minutes. And you get reliable, 99% yield.

Now consider this.

The Zehntel 3200 delivers all this capability for about one-third the cost of some other functional testers.

Just write or call for complete information today.

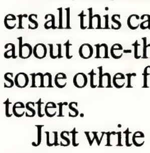
Otherwise, you're just wasting your time.



The Zehntel 3200 performance tester. Up and running in weeks.

Zehntel®

E 11/12/87


There ought to be a better way to test bus-structured boards.
Zehntel

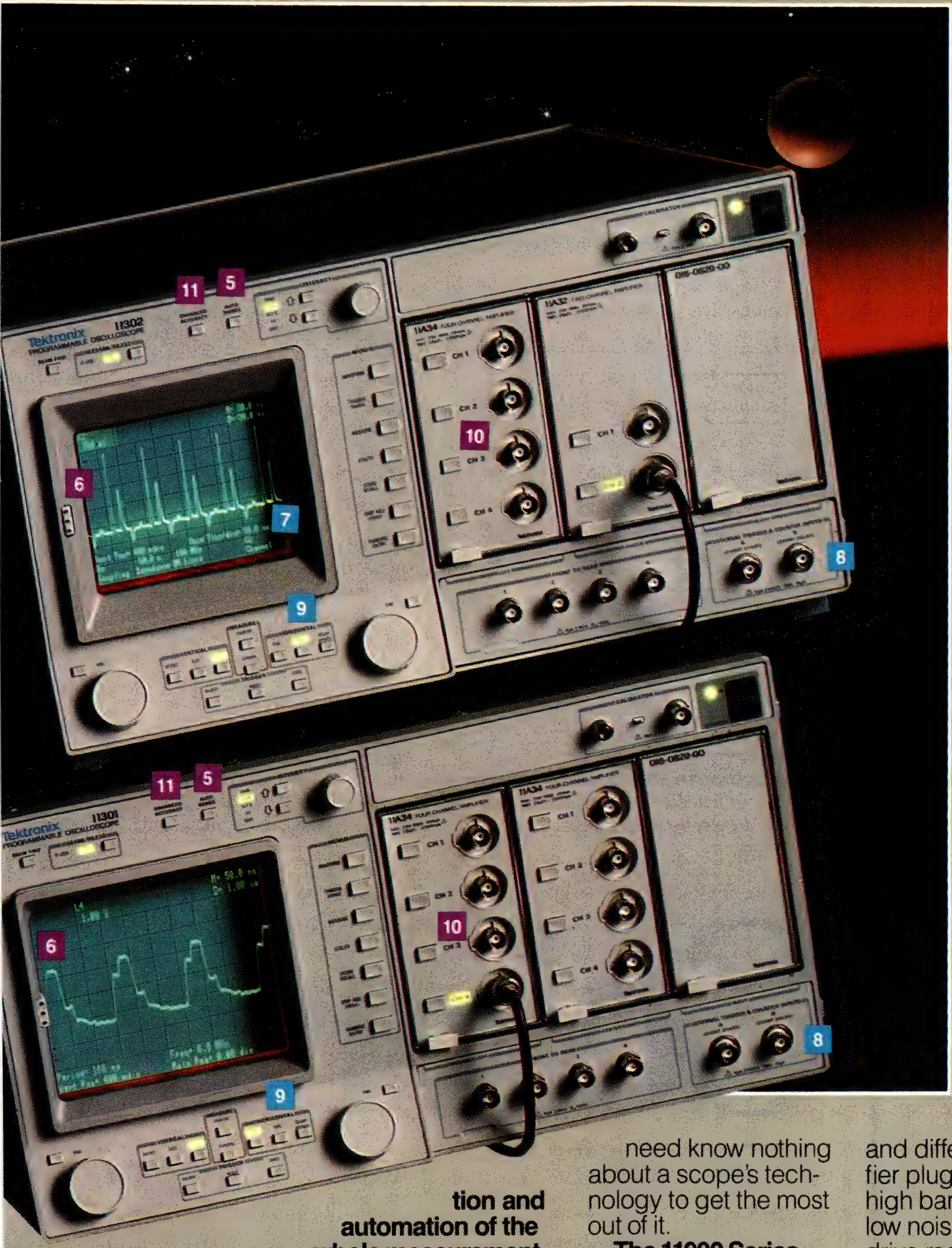
FREE POSTER

To get this free poster, call **(800) 457-8326** or attach your business card here and send to:

ZEHNTEL
2625 Shadelands Drive
Walnut Creek, CA 94598

Offer expires December 31, 1987.

Circle 41 on reader service card


11
5
Tektronix
11302
PROGRAMMABLE OSCILLOSCOPE
6
7
9
10
11A34 FOUR CHANNEL AMPLIFIER
11A32 TWO CHANNEL AMPLIFIER
CH 1
CH 2
CH 3
CH 4
8
11
5
Tektronix
11301
PROGRAMMABLE OSCILLOSCOPE
6
9
10
8

ANALOG

7 MICROCHANNEL PLATE. The single shot trace brightness of the Tek 11302 is almost 1000 times brighter than conventional scopes—enough to expose even the fastest transients to view.

8 500 MHz INTEGRATED COUNTER/TIMER. Use with dual delayed sweeps for precise timing measurements between selected points. Unique counter view trace lets you see exactly what you are triggering on.

9 CURSORS. Use to make precise measurements on any part of a displayed waveform.

10 1 mV/DIV SENSITIVITY. Achievable from four new plug-ins. These amplifiers feature fast overdrive recovery and wide dynamic range.

11 SELF-CALIBRATION. Push the Enhanced Accuracy button to calibrate the scope from amplifier input to CRT graticule, automatically, for the best vertical accuracy available in a scope today.

price of a scope alone. A unique counter view trace lets you see exactly what you are triggering on, for a sense of confidence no conventional counter/timer can offer.

Perhaps most startling is the simplification and automation of the whole measurement and analysis process. Larger displays, pop-up and touch-screen menus, plus automated setup and measurement capabilities help unclutter the front panel and keep eyes focused on the display. For the first time, users need know nothing about a scope's technology to get the most out of it.

The 11000 Series continues the plug-in versatility of the Tek 7000 Series. Five new plug-ins and three new probes tailor the new scopes to a full range of applications, from design and debug to production test. New single-ended amplifier and differential amplifier plug-ins combine high bandwidth with low noise and fast overdrive recovery.

Demonstrations are now in progress. For more information or a personal demonstration, get in touch with your local Tek sales engineer. Or call Tektronix at 1-800-547-1512.

Tektronix®
COMMITTED TO EXCELLENCE

Circle 43 on reader service card

with short-term stability improved to about 20 MHz from about 1 GHz. The other is optical heterodyne reception, enabling the system to be tuned to separate channels in the manner of superheterodyne microwave receivers. Wavelength-division multiplexing has been used in a small number of systems, but the difficulty of building filters to separate closely spaced wavelength beams at the receiving end has limited such systems to three or four channels.

FEEDBACK LOOP. The implementation of the NEC carrier-frequency stabilization method is innovative. It uses a feedback loop that includes a swept-frequency laser developed earlier by the lab and an optical resonator, used as an optical comb filter, that is about 10 mm long. This is the length of one round trip in air at 15 GHz, the spacing of the optical channels.

The starting frequency of the swept-frequency laser is slightly lower than that of the system's lowest-frequency channel, and its highest frequency is somewhat above the highest-frequency channel. The resonator filters out all but harmonics of 15 GHz from the swept-frequency laser as the rising laser frequency successively passes through integral multiples of 15 GHz.

Each signal peak at the output of the resonator can be considered similar to one of the high-order harmonics from the crystal oscillator often used as a reference to lock the frequency of a microwave system. One difference is that the time at which each appears during the excursion of the swept-frequency laser indicates which of the many resonances it is—that is, its frequency.

As shown in the figure, the resonator output signal is detected to provide timing information. A portion of the swept-laser signal obtained ahead of the resonator is fed into an automatic frequency-control loop where it is used as the reference signal to control in turn the frequency of each of the many lasers in the system.

Outputs of the modulated lasers are combined for transmission. A small portion of the combined outputs is tapped off for use by the automatic frequency-control circuit. The swept-laser signal at the resonator output and the combined modulated laser signals are heterodyned together in the second optical detector to generate a microwave signal whose frequency determines the AFC loop-correction current applied to each particular laser.

At the receiving side, a laser diode is used as the local oscillator to heterodyne in a balanced mixer the signals arriving from the transmitter. Arriving signals would be pulse-frequency or pulse-phase modulated in the manner of modem signals.

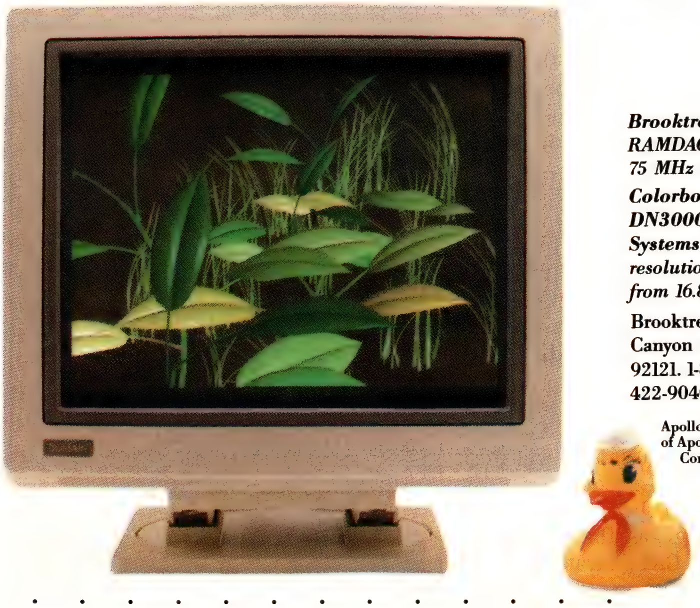
Coherent reception provides higher sensitivity than is possible with present systems. In a nonmultiplexed system with its new technology, NEC researchers have achieved transmission over 300 km at a data frequency of 34 Mbits/s, without repeaters. *–Charles L. Cohen*

MILITARY

A PAPERLESS DOD: ARE SUPPLIERS SET?

DETROIT

The Defense Department's two-year-old drive to convert its weapons systems documentation from paper to an electronic data base will cost billions of dollars and take more than a decade. But despite top-level industry involvement, knowledge of CALS (for Computer-aided Acquisition and Logistics Support) and its implications has not yet trickled down to many second- and third-tier defense suppliers, DOD officials say. That's why the Autofact show that starts Nov. 10 in Detroit will devote



Brooktree®

Brooktree Bt458. Triple 8-bit color RAMDAC. Available in speeds from 75 MHz to 135 MHz.

Colorboard upgrade for Apollo DN3000 and DN4000 Domain Systems. Provides 1024 x 800 screen resolution. Displays 256 colors from 16.8 million color palette.

Brooktree Corporation, 9950 Barnes Canyon Road, San Diego, California 92121. 1-800-VIDEO IC or 1-800-422-9040, in California.

Apollo and Domain are registered trademarks of Apollo Computer Inc. © Copyright Brooktree Corporation 1987.

Circle 45 on reader service card

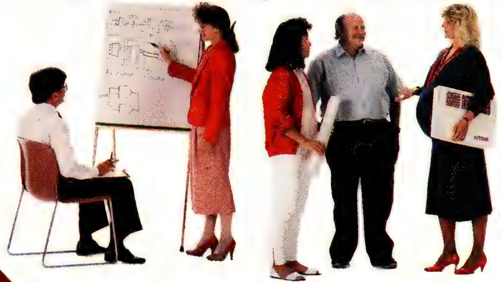
53.6 Reasons to Choose P-CAD for CAE and PCB design.

• End-to-end PCB design • Workstation performance • 53.6% market share* • New! SMT support

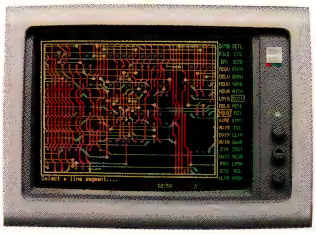
• Low cost schematic design • Auto place & route (45°) • Large board capacity • ASIC design kits

• Operates on standard hardware • Full range of system interfaces • 3000+ component library

• Design rule checking • Absolute data security • 3rd party software & services • 24-hour on-line support



• Local sales & training



To find out why 53.6% of engineers using PC-based CAD systems choose P-CAD® for workstation level performance, call toll-free:

800-523-5207 U.S.
800-628-8748 California

p-cad®
PERSONAL CAD SYSTEMS INC.

Personal CAD Systems, Inc.
1290 Parkmoor Avenue
San Jose, California 95126 USA
Telex: 371-7199 FAX: 408-279-3752

New! State-of-the-art Generation 2.0™

*Source: Dataquest, Inc.
P-CAD is a registered trademark of Personal CAD Systems, Inc.
Generation 2.0 is a trademark of Personal CAD Systems, Inc.

Circle 47 on reader service card

Light stable, flame retardant plastics?

Take a tip from Nixdorf: Talk to Bayer.

Type 8812 computerized cash register keyboard and line display housing made of Bayblend

If you're looking for the right material, why not do as Nixdorf's design engineering department did: talk to Bayer!

For the cabinet and keyboard of their type 8812 computerized cash register, Nixdorf now use the PC/ABS blend Bayblend. This is a thermoplastic noted for its outstanding light stability, good flame retardance and high heat resistance.

Bayer has one of the world's biggest ranges of high-performance engineering plastics:

®Apec (PAR), ®Bayblend (PC + ABS), ®Bayfol (PC blend film), ®Baygal/®Baymidur (PUR casting resins), ®Desmopan (TPUR), ®Durethan (PA 6, PA 66), ®Leguval (UP), ®Lekutherm (EP), ®Makroblend (PC blends), ®Makrofol (PC film), ®Makrolon (PC), ®Novodur (ABS), ®Petlon (PET), ®Pocan (PBT), ®Tedur (PPS).

Whether it's light stability, flame retardance or some other property you need:

Talk to Bayer, and together we'll find the answer to your material problems.

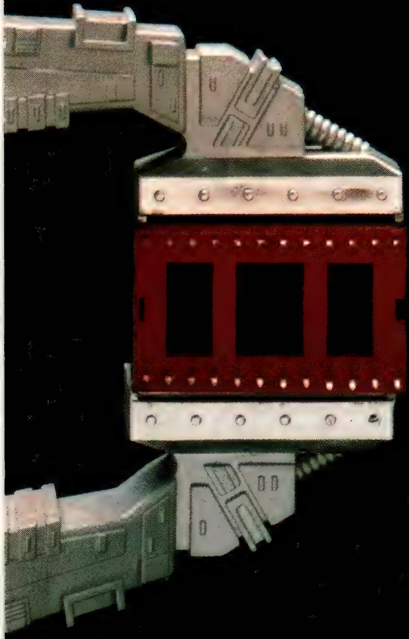
For more information write to:
Bayer AG, AV-Informationsvermittlung
Postfach 80 0149, D-5000 Köln 80

5/KU 3976e.i. 511/10.87

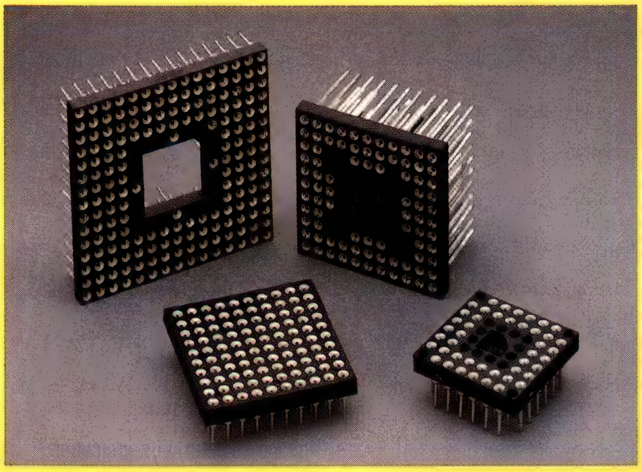
Plastics Business Group

Bayer

Circle 162 on reader service card



The RN "Partners in Quality Team" delivered precision sockets that made automatic assembly possible!



Application Specific PGA Sockets
Robinson Nugent offers a wide variety of Pin Grid Array Sockets for your ASIC's. They feature: High temp bodies for wave soldering • Disposable pin carriers for zero profile contacts • Sizes, 8x8 up to 21x21 with unlimited configurations • Extraction tools available • Molded standoffs for socket body. Write today for complete new PGA catalog.

CIRCLE NO. 164

"The 'RN P/Q TEAM' concept brings all of our design, engineering and production skills to bear on *your* unique socket/connector problems. We work closely with your people to create solutions that are delivered on-time and defect-free. *You have my personal guarantee on it."*

R.A. Lindenmuth

R. A. Lindenmuth
President/CEO

Some Companies Prefer To Preach Quality, We Prefer To Prove It.
ROBINSON-NUGENT
PQ
PREFERRED QUALITY

Write or call today for the comprehensive new brochure: *"The RN P/Q Team in Action".* You'll learn how smart companies are putting the brains, resources and experience of RN engineers to work to solve tough interconnection problems with speed and efficiency.

CIRCLE NO. 51

PQ The "RN P/Q TEAM"...your Partners in Quality

INTERNATIONAL NEWSLETTER

TURNABOUT IS FAIR PLAY: IBM COMPUTERS NOW RUN FUJITSU SOFTWARE

IBM Corp. is getting a chance to reclaim some of the Japanese mainframe market that had been captured by IBM-compatible mainframes. That's because the recently arbitrated settlement between IBM and Fujitsu Ltd. cuts both ways. It gives the Japanese computer maker access—for a price—to IBM system software so its systems can run IBM applications with little adaptation. But it also opens the way for IBM systems to use Fujitsu software. Under the terms of the settlement, IBM Japan has come up with special software, called migration programs, that let software written for Fujitsu machines run on IBM computers. Kawasaki-based Fujitsu had never licensed its operating-system software for use on any but its own machines, but the American Arbitration Association's order gives customers a right to license Fujitsu software, in countries where it is marketed, for use on IBM machines. Unpatched applications written for Fujitsu machines can thus run in Fujitsu's OSIV/F4 MSP E20 operating environment, which in turn runs under the VM operating system of an IBM 4381 computer thanks to the migration-program interface. Although it sounds cumbersome, this arrangement does not impose significant overhead, largely because of the similarity between the IBM and Fujitsu machines. Migration programs have also been developed for Hitachi software, so it is now possible to replace Fujitsu or Hitachi mainframes with an IBM product or to add an IBM system in a Fujitsu or Hitachi environment. Only time will tell whether IBM can regain market share in this way. ☐

IBM AND SIEMENS TEAM UP TO STUDY WAYS TO BUILD SMART NETWORKS

The web of international linkups in information processing, which unites friends and sometimes foes, now ties West Germany's Siemens AG to IBM Deutschland GmbH, a subsidiary of the U. S. computer maker. The two are embarking on a joint study of intelligent communication networks. They are considering linking IBM computers with Siemens telephone-exchange systems to form networks that allow callers to charge call fees to credit cards and use other new types of services. The pact brings together two powerful partners, each strong in an area where the other is weak. IBM, the world's biggest computer maker, could use a boost in communications technology. And Siemens, No. 3 in the world in communications, could use a shot in the arm to bolster its relatively weak presence in international computer markets. Industry observers in West Germany suspect that after its rather unhappy marriage to Rolm of Santa Clara, Calif., IBM sees the need for a stronger partner to develop the networks of the 1990s. ☐

NEC IS PILING ON MORE ASIC CAPACITY IN JAPAN AND U. S.

In reaction to a rapidly increasing demand for application-specific integrated circuits, NEC Corp., Tokyo, plans to build a new line for assembling ASICs into their packages at its Roseville, Calif., plant, and two ASIC wafer-fabrication lines at a manufacturing subsidiary, NEC Kyushu Ltd., in Kumamoto. The new line at the Roseville plant, which is now manufacturing 3 million to 3.5 million 256-Kbit dynamic random-access memories a month, will start assembling gate arrays into packages at the rate of 10,000 to 20,000 units a month at the beginning of next year. NEC will invest $7.3 million for the new line. At Kyushu, some $62 million will initially go into the 6-in. wafer-fab lines, which are scheduled to manufacture custom and semicustom microcontroller chips and gate arrays at the rate of 1,000 wafers per month starting next April. With additional investment, the lines' capacity will be boosted to some 10,000 wafers a month by the latter half of next year. NEC expects the ASIC percentage of its semiconductor sales to rise from the present 38% to 50% within two to three years. ☐

SIEMENS

Systematic data transmission

Optical fiber interface module ODCL

For many years, Siemens has been investing its entire know-how into intensive research into the relatively young field of optical fiber technology.

The result: User-oriented solutions, made-to-order for each field and each customer. Whether in a complete system or as a individual component for linking, converting, transmitting, receiving, switching, branching, coupling or mixing.

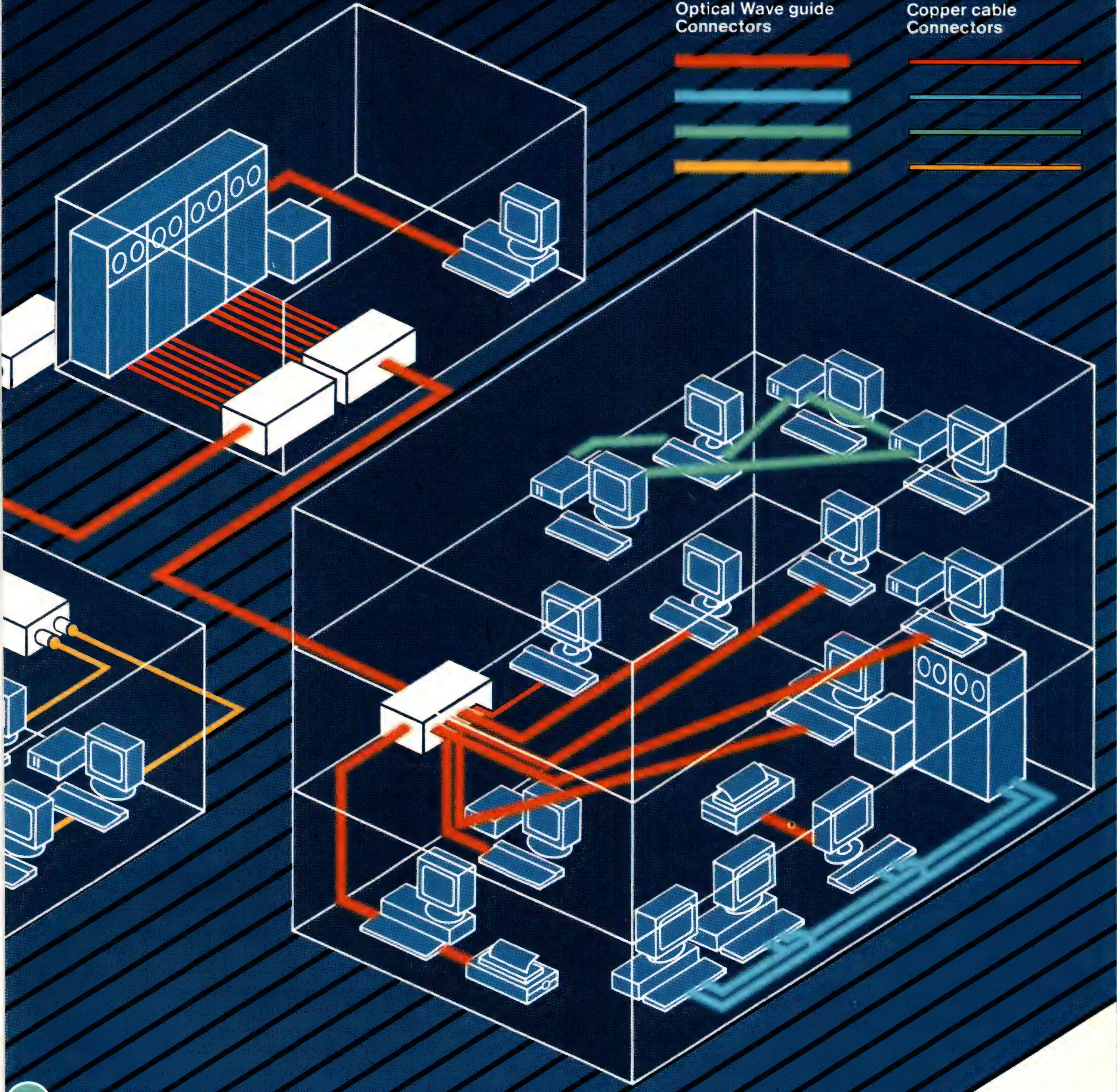
The full-duplex ODCL interface modules, with data rates up to 8 MBd/channel, represent a further step in this development. An ODCL system can be used to realize both simple point-to-point connections (ODCL 1) as well as complex network configurations via multiplexers (High Speed ODCL 3). Thanks to their modular design, the individual system components are compatible with conventional coaxial and wire connections; this means an enormous increase in performance for connections of this type.

The ODCL interface modules are available in the following standard versions: RS-232C, RS-422A and TTL (single or multiple channel).

Other module versions can be designed to a customer's specific requirements. Siemens' ODCL interface modules ensure that optical data transmission worldwide is just how it should be: Quick. Reliable. Precise.

Fiber Optic Components from Siemens

The following pages will show you a number of different applications for ODCL interface modules in a complex network configuration.



● **Simple Ring**
In this network configuration, several stations can communicate with each other on an equal basis. With ODCL modules, interface conversion is also possible at the same time.

● **Token Ring**
With optical fiber LAN adapters AD1, AD2, AD3 and the optical fiber bypass relay, an existing coax token ring LAN can be expanded to a complete optical fiber ring network with no restrictions with regard to section length (coax 500 m – optical fiber 4 km) and interference susceptibility (EMI).

Circle 159 on reader service card

Coupon:

To Siemens Infoservice 143/Z164
Postfach 2348, D-8510 Fürth 2

Yes, I would like to know more.
Send me further gratis information.

Name ____________________
Street ____________________
Zip code, city ____________________

INTERNATIONAL WEEK

OUTPUT OF GERMAN PROCESSORS FALL

West German production of data-processing equipment during the first seven months of 1987 fell 6% compared with the same period last year, says the country's electronics industry association, based in Frankfurt. The prime reason for the decline is the slowing output of data-storage systems, which dropped 21%, and of plotters and other recording systems, which fell 15%. Central processing units stayed at last year's level.

JAPANESE TO MAKE ERASABLE DISKS

Japanese chemical companies are preparing for mass production of erasable magneto-optic disks starting next year. Three firms, Daicel Chemical Industries Ltd. and Sumitomo Chemical Co., both of Osaka, and Mitsui Petrochemical Industries Co. of Tokyo, have developed prototypes, but are disclosing specifications only to disk-drive makers actively developing drives. Sumitomo will start marketing first, in January 1988, with 100,000 units in the initial year. Mitsui and Daicel do not have firm plans yet. All the disks are plastic-based, such as polycarbonate substrate for Daicel and amorphous polyolefin for Mitsui.

STRONG GROWTH SEEN FOR EUROPE

The year ahead could be the best one for the European electronics industry since 1984, reports a British market forecaster. The 1988 market for electronics equipment and components is estimated to be $144 billion (at constant 1986 values and exchange rates), a real growth of 7.5% over 1987. By contrast, 1987 growth is estimated at 4.4%. Growth higher than 7.5% was last logged in 1984, when a spurt of 13% was recorded, according to Benn Electronics Publications in its 1988 *Yearbook of West European Electronics Data.* The Luton, England, forecaster singles out data processing as the most buoyant sector for 1988 and consumer electronics as the least promising.

ASAHI ENTERS LCD TV MARKET

The first Japanese camera maker to enter the market for liquid-crystal-display TV sets, Asahi Optical Co. of Tokyo, will market a color LCD TV with a 3-in. screen starting Dec. 1 in Japan. The thin-film-transistor active-matrix screen, with a resolution of 92,160 dots, will be supplied by Sharp Corp., Osaka. It is a redesigned private-label version of the 3-in. color LCD TV that Sharp started selling last month [*Electronics,* Oct. 15, 1987, p. 54]. Asahi expects its set to help increase the sales of its 8-mm camcorder, which is made by Hitachi Ltd., since the TV can be used as a portable monitor for the camcorder. The firm hopes to sell 2,000 units a month at 49,800 yen.

NATIONAL TO CLOSE GERMAN PLANT

Look for National Semiconductor Corp. of Santa Clara, Calif., to shut down its Wasserburg, West Germany, production plant by the end of this year. The facility was part of Fairchild Semiconductor Corp., which has been bought by National. About 270 people will be affected by the shutdown. National will shift the Wasserburg production to its plant in Singapore.

SIEMENS, DEC TO LINK OA EQUIPMENT

Munich-based Siemens AG and Digital Equipment Corp. of Maynard, Mass., have agreed to cooperate in applying each other's equipment in office automation. That means that the German firm's private switching systems could be coupled to DEC computers in certain office environments. For example, a DEC VAX computer could make a Siemens switch establish phone connections. Conversely, a Siemens switch could make a VAX computer display on a terminal screen information stored by the computer.

ALCATEL TEAMS WITH SGS-THOMSON ...

Alcatel NV, the European telecommunications giant formed last year when France's Compagnie Générale D'Electricité bought the European telecommunications interest of ITT [*Electronics,* July 24, 1987, p. 113], has signed up an ally for semiconductor expertise. The new partner is SGS-Thomson, the joint company that France's Thomson Semiconducteurs and Italy's SGS-Microelettronica recently put together [*Electronics,* June 11, 1987, p.54C]. From the deal, Alcatel will get a leg up for telecommunications chips. SGS-Thomson, in turn, will have better access than its competitors to the technology of Alcatel, whose sales last year reached $12.7 billion.

... ADDS PARTNERS IN CELLULAR RADIO

To cash in on the booming European cellular radio market, Alcatel will throw its lot in with Nokia Group of Finland and AEG of West Germany. The three firms have agreed to form a consortium to develop and market cellular radio gear.

PLESSEY TO SUPPLY SYSTEM X TO CHINA

Plessey Telecommunications Systems has won a contract worth over 6 million pounds to supply China Railways in the People's Republic of China with its System X, a public switching system. Twenty-six local exchanges with a capacity of 24,000 lines and remote concentrators will be delivered by 1989 for the Zhengzhou to Baoji Railway Electrification Project. This was Plessey's second major System X international sale, after one to Colombia.

ADVANCED E-BEAM PLANT OPENS

European Silicon Structures Ltd. of Edinburgh has opened the first second-generation electron-beam processing plant in Europe. The direct-write, fast-turnaround silicon prototyping plant in Rousset, in southern France, will produce small quantities of application-specific integrated circuits under tight deadlines. A year ago, the company installed the world's first such machine in San Jose, Calif., for Exel.

CHIPS BOUNCE BACK IN UK

The UK book-to-bill ratio for semiconductor sales bounced back to 1.36 in September after tumbling from 1.40 in July to 0.91 in August, says the Electronic Components Industry Federation. The industry shows signs of growth compared with a year ago, when the book-to-bill ratio was 0.82 in September. The growth, however, is primarily in data processing, notes the ECIF.

SIEMENS PRINTERS GET 18 NEEDLES

Siemens AG has added two color units to its lineup of needle printers, both based on 18-needle print technology. Intended for Siemens-made personal computers and all IBM PC-AT-compatible systems, the new printers can produce up to three copies. The $940 PT18 and $1,165 PT19, for paper widths up to 250 mm and up to 400 mm, respectively, print as many as 300 characters per second in the rapid-print mode.

Dauvin. "For the first time ever, Avions Marcel Dassault is laying off people." France's only fighter aircraft manufacture, Dassault also manufactures jets for the corporate market. "For Thomson, the growth is just not there," says Dassault. "It's true that this sector is going to be using more and more integrated circuits in the future but for the moment, orders are dropping and production is flat."

In another area, the French are now spending as much time watching television as working, which means the market for consumer components is beginning to grow, says Dauvin.

But the most important factor leading to an increase in the consumer segment for France—and the rest of Europe—this year is automotive components, he says. Although automotive electronics currently represent a relatively small slice of the consumer-sector pie, Dataquest research indicates that future growth for the European market lies in this area. *– Jennifer Schenker*

ECHO-CANCELING CHIP SET GIVES A BIG BOOST TO ISDN

A two-chip set from Philips pushes the emerging Integrated Services Digital Network closer to reality by implementing echo-canceling functions for the European version of the ISDN interface between the customer's premises and the telephone company's central-office switch.

The PCB2390 set conforms to the West German Bundespost's U_{K0} version of the U-interface specifications as defined by the International Telegraph and Telephone Consultative Committee, or CCITT. The U_{K0} specs cover transmission requirements, protocols, and activation and deactivation procedures. Philips will introduce its chips at the Paris Components Show.

Mounted in the network termination box at subscriber premises, the echo-canceling chip set allows existing subscriber wiring to carry integrated voice, data, and video signals over distances up to 8 km. A second set used in a repeater station extends the distance to 14 km.

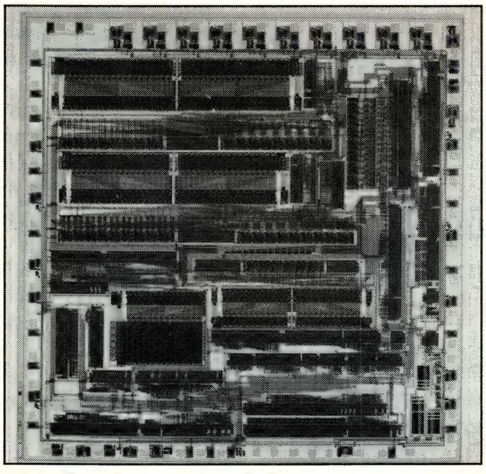
To assure compatibility with a wide range of ISDN chips, the Philips engineers adopted the industry-standard IOM (for ISDN-Oriented Modular) interface [*Electronics,* Oct. 1, 1987, p. 64]. Similarly, engineers implemented the 4B/3T line-code format used for Europe's ISDN products. The format reduces the required transmission speed by mapping every four incoming bits into three ternary digits. In the U. S., a 2B/1Q scheme—two binary digits converted to one quaternary digit—has been proposed.

The set includes an analog chip that includes filters, analog-to-digital converters, and activation detectors. A companion digital chip handles digital-signal-processing functions.

The two chips consume about 60 mW in standby and 300 mW active, but the production versions will cut those figures approximately in half.

The 2390 has two pipelined transversal filters with 30 coefficients. The filters act as programmable artificial lines, eliminating echoes and adapting to line transients.

STORED COEFFICIENTS. At initial power up, the processor section places a signal on the subscriber line, detects the resulting state of the line, and adapts and stores the required filter coefficients. These coefficients remain stored even during power down. They are always updated during normal operation.



DSP. The digital half of Philips' chip set cancels echoes using digital-signal-processing techniques.

During normal operation, the filters automatically compensate for differences in line length and line characteristics and remove echoes. With the 2390, this adaptive echo-cancellation and equalization routine typically converges within 100 ms from power-off or the test state. The processor also extracts timing information from the signal, and performs non-linearity compensation to allow for easy analog design.

Before placing outgoing voice or data onto the subscriber line, the circuits first scramble the bit stream to ensure that the echo canceler is working correctly. The cancellation algorithm is based on the fact that there should be no correlation between outgoing and incoming signals. Therefore, upstream and downstream data are scrambled differently, and different framewords are used in each direction. Signals from the subscriber line are smoothed by an on-chip third-order low-pass filter and digitized by a 10-bit analog-to-digital converter. At this point, the total signal includes the desired incoming signal, an attenuated version of the outgoing signal, and echoes.

The chip set passes on maintenance information, counts errors, and activates and deactivates the transmission link. Adaptive filters, for example, are used to connect to loops containing the unterminated branches from a line when a subscriber hangs up.

Made in 2.5-μm CMOS technology, the set is now available as samples for evaluation by equipment makers. A single-chip version using 1.5-μm technology is planned for 1989—assuming market interest is big enough, says Wouter Bourgonje, international marketing and sales manager for telecom circuits at the Electronic Components and Materials Division in Eindhoven, the Netherlands.

Although the Bundespost-proposed U_{K0} specifications are considered only an interim solution—worldwide specs are not likely for several more years—Bourgonje expects the PCB2390 to become popular with equipment makers ready to try echo-canceling in ISDN networks. Bourgonje sees sales of 100,000 next year, and 200,000 in 1989. Really big sales volumes of echo-canceler chips—of whatever specification in force by then—won't come until the first half of the next decade when ISDN systems will be standard equipment, the Philips manager says.

The digital part comes in a 68-pin ceramic leadless chip carrier and the analog part in a 40-pin dual in-line ceramic package. Prices will depend on the importing country, but should be about \$80 each in 1987 and \$50 by the end of 1988. *– John Gosch*

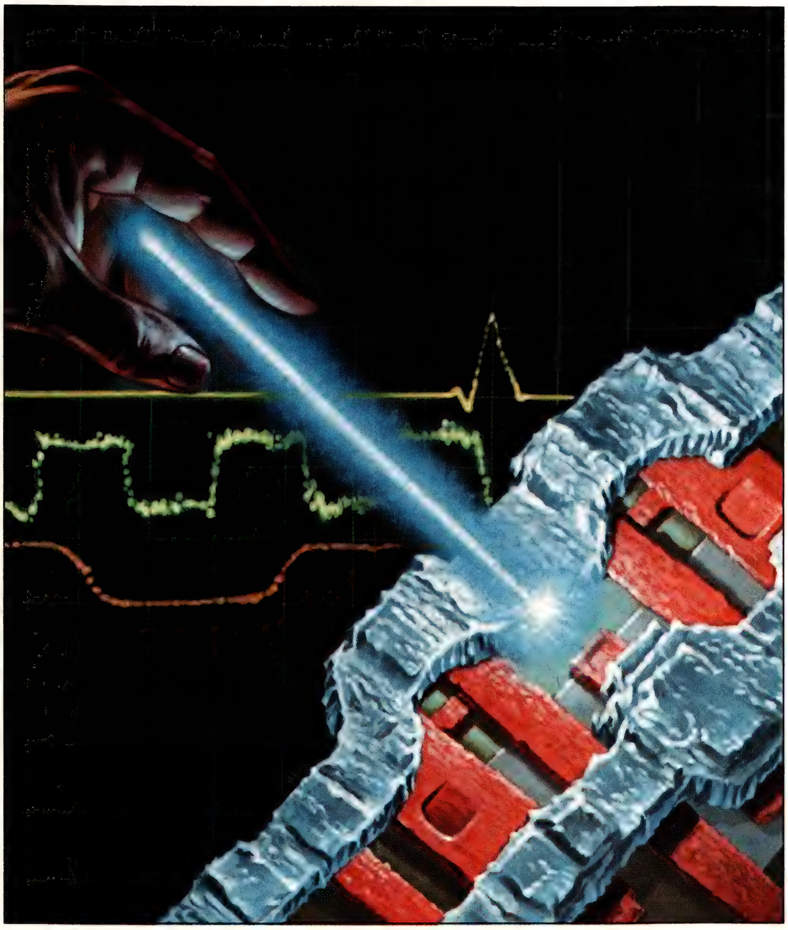
Philips Elcoma, P.O. Box 523, NL-5600
Eindhoven, The Netherlands.
Phone 31-40-722091 [Circle 502]

DOUBLE-DUTY TUBE SAVES RADAR SPACE

Airborne radar systems can pack more performance into less than half the space now needed by using a new waveguide tube from Thomson-CSF that combines the functions of two tubes—one for scanning the ground and the other for sky-scanning. It is being introduced at the Paris Components Show.

Thomson's Th3678 dual-mode, coupled-capacity traveling-wave tube deliv-

BUG ZAPPER.



The IDS 5000 integrates E-beam probing with CAD/CAE tools; it marries netlists, layout, and scope with a 'live' microscopic image of the chip.

Sentry Schlumberger's New Tool Slashes VLSI Debugging Time.

"A new diagnostic tool promises to cut weeks off the time required to debug prototype VLSI devices that have submicron feature sizes. The Integrated Diagnosis System 5000 from Sentry Schlumberger Inc. of San Jose, Calif., uses an electron-beam probe and combines data from a complex VLSI chip's CAD netlist with an actual microscope image of the chip.

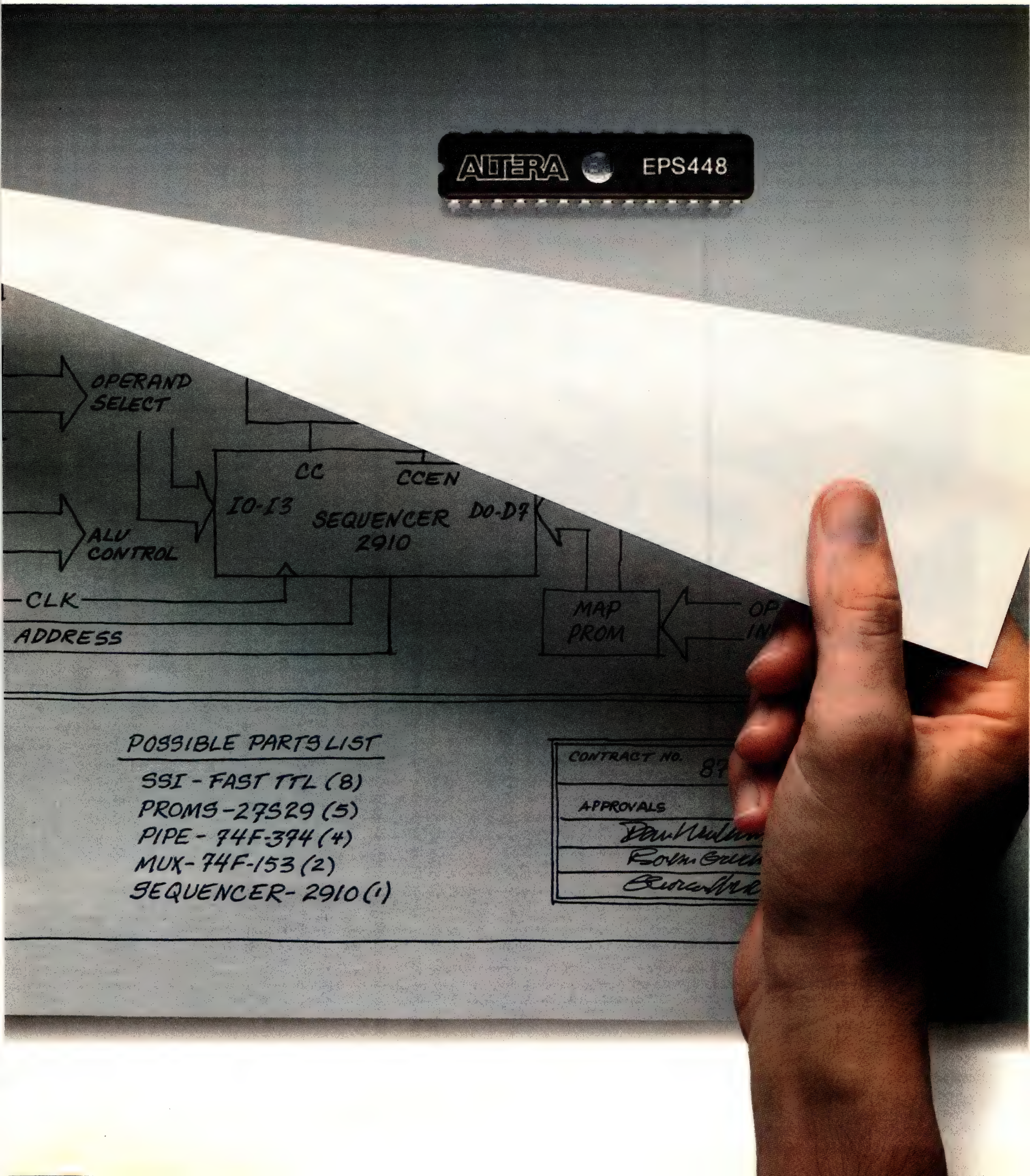
The IDS 5000 is the first debugging system to integrate front-end design data—netlists and connectivity—with back-end layout data—the physical chip layout. In addition, this system for the first time makes scanning-electron-microscope technology available to designers in an engineering lab..."

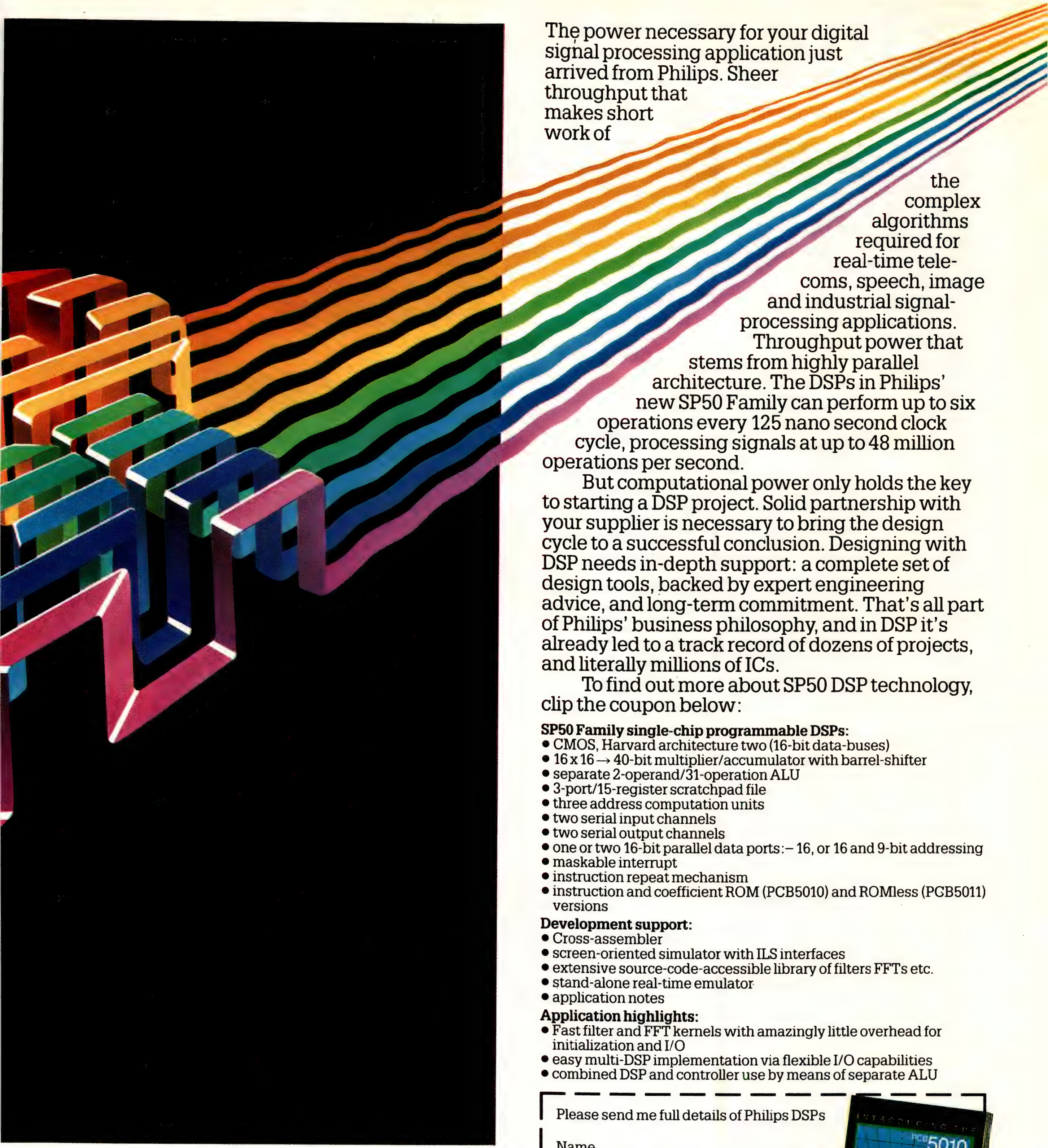
Excerpted from an exclusive article in the April 30, 1987 issue.

McGraw-Hill Electronics

THE LEADER IN NEW TECHNOLOGY COVERAGE

State of Mind.





The power necessary for your digital signal processing application just arrived from Philips. Sheer throughput that makes short work of the complex algorithms required for real-time telecoms, speech, image and industrial signal-processing applications.

Throughput power that stems from highly parallel architecture. The DSPs in Philips' new SP50 Family can perform up to six operations every 125 nano second clock cycle, processing signals at up to 48 million operations per second.

But computational power only holds the key to starting a DSP project. Solid partnership with your supplier is necessary to bring the design cycle to a successful conclusion. Designing with DSP needs in-depth support: a complete set of design tools, backed by expert engineering advice, and long-term commitment. That's all part of Philips' business philosophy, and in DSP it's already led to a track record of dozens of projects, and literally millions of ICs.

To find out more about SP50 DSP technology, clip the coupon below:

SP50 Family single-chip programmable DSPs:
- CMOS, Harvard architecture two (16-bit data-buses)
- 16 x 16 → 40-bit multiplier/accumulator with barrel-shifter
- separate 2-operand/31-operation ALU
- 3-port/15-register scratchpad file
- three address computation units
- two serial input channels
- two serial output channels
- one or two 16-bit parallel data ports:– 16, or 16 and 9-bit addressing
- maskable interrupt
- instruction repeat mechanism
- instruction and coefficient ROM (PCB5010) and ROMless (PCB5011) versions

Development support:
- Cross-assembler
- screen-oriented simulator with ILS interfaces
- extensive source-code-accessible library of filters FFTs etc.
- stand-alone real-time emulator
- application notes

Application highlights:
- Fast filter and FFT kernels with amazingly little overhead for initialization and I/O
- easy multi-DSP implementation via flexible I/O capabilities
- combined DSP and controller use by means of separate ALU

Please send me full details of Philips DSPs

Name__________
Position/file__________
Company__________
Address__________
____
__________ Postcode__________
Country__________
E 11/87

Philips Electronic Components and Materials Division,
Building BA, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Telex 35000 phtc/nl

The name is Philips.
The product is DSP.

Circle 65 on reader service card

PHILIPS

FURTHER IMPROVEMENT IN OUR RANGE OF

POWER LINE COMBI FILTERS

A WIDE CHOISE FOR EXTENSIVE APPLICATION RANGE

Model	Features
FKSO	1 fuse 5 × 20 or 6.3 × 32
FKSP	2 fuses 5 × 20 or 6.3 × 32
FKSQ	as FKSO, with voltage selection
FKSR	as FKSP, with voltage selection

All models are equipped with a 2-pole switch.

Approvals obtained or applied for worldwide.
Please ask for detailed literature.

TIMONTA AG
Switzerland

S. Martino, CH-6850 Mendrisio
(091) 48 01 31 – Tlx 842248 – Fax (091) 462659

We exhibit at
SALON DES COMPOSANTS
Paris, 16–20 Nov. 1987
hall 4, allée 46, stand 35

GATE ARRAYS' BIG PROBLEM: THEY TAKE TOO LONG TO BUILD

Four firms are now offering laser-based answers for fast prototyping to shorten their customers' product lead times; are instant custom circuits next?

by Bernard C. Cole

Time to market is always a bugaboo for makers of electronic systems, but the problem has been intensifying as product lifetimes have progressively shortened. And makers and users of semicustom chips feel the pressure even more because of the need to generate prototypes before a system can be debugged and demonstrated, much less marketed.

Now, relatively low-cost laser-based fast-turnaround prototype methodologies promise to solve this problem for gate arrays, putting prototypes in the hands of system designers in hours or even minutes so they can make sure their systems work and start demonstrating them to customers. They join direct-writing electron-beam systems—far more expensive at $5 million to $10 million apiece—in the business of producing gate-array prototypes fast.

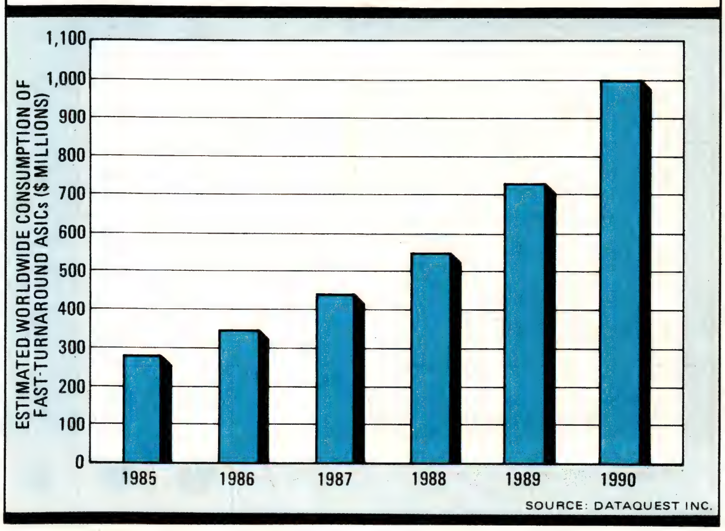
Such companies as Laserpath, Lasa, Elron, and Lasarray are developing very different laser-based technologies: lasers are being used, for example, both to cut prefabricated interconnect lines and to write them directly. They have equally varied approaches to the marketplace.

Laserpath Corp. of Sunnyvale, Calif., keeps its system in-house, where it offers quick-turn services to gate-array users. Lasa Industries Inc. of Santa Clara, Calif. (see p. 72), and Elron Electronic Industries Ltd., Haifa, Israel (see p. 76), sell complete turnkey systems. Lasarray Corp. of Irvine, Calif., and Bid, Switzerland, does both: it offers fabrication services and sells systems.

Besides gate-array manufacturers, other segments of the electronics industry should benefit from the new quick-turn technologies. Large original-equipment manufacturers will use them to shorten product lead times; computer makers should be particularly intrigued. Consumer- and military-electronics companies are likely prospects. And IC distributors may well see the new systems as a way of making deeper inroads into the semicustom business.

Because of its cost, e-beam technology is an option open to the only the largest OEMs and systems houses. E-beam is increasingly used at companies such as AT&T, Hewlett-Packard, Hitachi, and Philips, as well as some of the larger chip companies, such as Texas Instruments and Fairchild. But in most cases, their applications have been limited to customizing the photoresist,

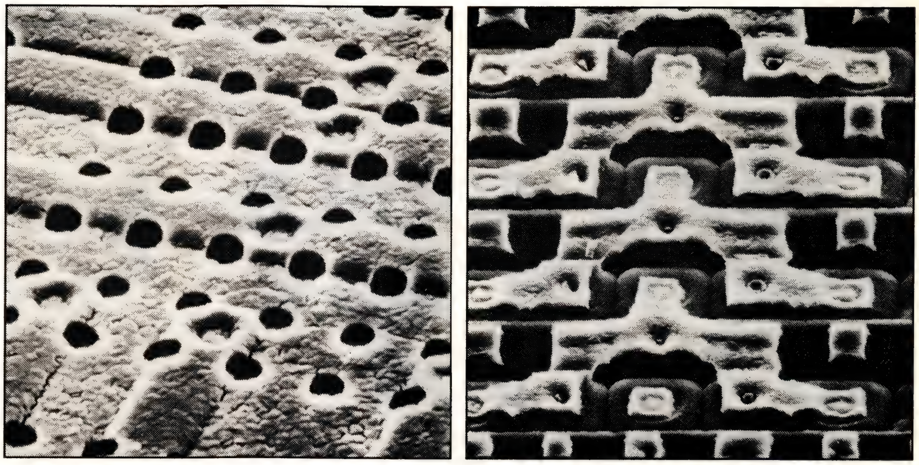
STRONG GROWTH FOR FAST-TURNAROUND CHIPS



SOURCE: DATAQUEST INC.

Laserpath keeps secret the details of its technology, operating as a quick-turnaround service for customers who need prototypes in days. The company uses preprocessed and prepackaged 2- and 3-μm chips and claims a turnaround time of no more than seven days from netlist to first prototypes. Plans are under way to cut that to under three days for prototypes.

Laserpath's initial family of single- and double-layer-metal CMOS gate arrays ranges in density from 880 to 3,600 gates. They are customized using an yttrium-aluminum-garnet infrared laser that etches away metal traces on specially prepared dice using a "cut-point extraction" control program to identify points that must be cut. In a new generation of higher-density arrays ranging from 5,000 to 8,400 gates, the company uses a combination of laser etching plus a nonlaser fabrication technique.



QUICK PATTERN. A layer of metal on a 2,400-gate Lasarray chip (left) is etched to form interconnect patterns (right) through a laser-based positive-resist exposure.

Lasa and Elron are nearly ready to take the wraps off laser-fabrication systems that will be offered directly to customers as turnkey systems. But here the similarities end.

The $500,000 Elron system uses a direct-write laser micromachining technology in which specially prepared and prepackaged dice are customized by cutting interconnect lines at certain points. In addition to dice with some built-in special features, this approach requires that the CAD-based design be translated into a special "cut list" using an Elron-supplied program. Elron says the system can handle CMOS gate arrays with densities up to 50,000 gates. Initial offerings, however, will allow fabrication of arrays only up to about 2,500 to 5,000 gates.

The $3 million Lasa system, on the other hand, uses a laser to actually lay down the last two layers of metal interconnect on standard unmodified gate arrays that have been prepackaged. Capable of working with gate arrays with geometries as small as 1 μm, the Lasa system lays down either one or two layers of tungsten interconnect atop standard gate arrays, plus silicon dioxide dielectric between the tungsten layers.

According to Zvi Or-Bach, inventor of the Elron system, the first beneficiaries of laser-based gate-array metalization systems will be the manufacturers of gate arrays themselves. With costs of gate arrays dropping rapidly, a major point of differentiation among vendors will be their ability to deliver finished prototypes faster.

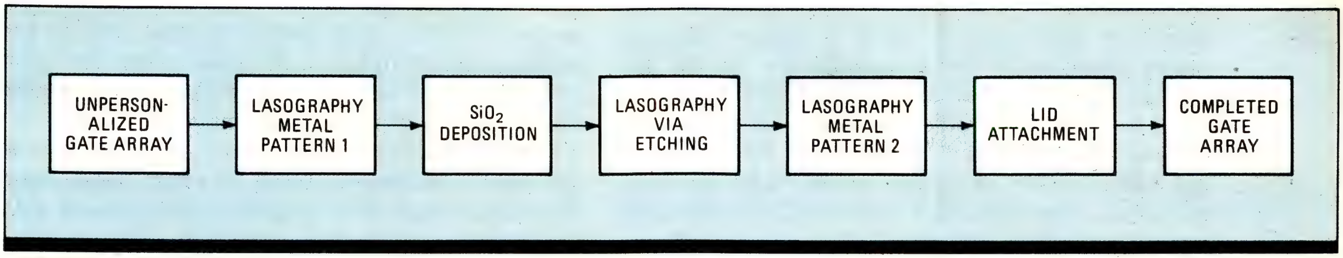
Also at the head of the user line will be large OEMs, says Dan Dooley, president of Lasa. "Some of these companies are spending as much as $25 million a year in nonrecurring engineering costs just to get those first 10 or 20 prototypes," he says. Besides giving such OEMs a lower-cost way of generating high-density prototypes, says Dooley, the new systems will slash the time it takes to get products to market. Even more important, he says, is that such quick-turn systems bring more of the design and fabrication process back under the control of the users.

Large and small computer makers will also jump on the bandwagon, Dooley predicts. "No matter whether it is a supermini or a personal computer," he says, "the designers need to know as quickly as possible in the system-development cycle whether a chip works and if not, why."

Laser-fabrication systems could open up new possibilities for gate arrays in the consumer market, too. "In such areas as electronic games and toys, semicustom gate arrays are not used because of the high nonrecurring engineering costs involved," Dooley says. "These guys need prototype systems that they can take around to customers and to shows, to see what the response is."

Yet another significant potential market is the military. "In the military, the need is critical for a quick and efficient way of turning out a lot of different designs quickly, but in relatively small quantities," says Or-Bach of Elron. The new systems also enhance security: "Everything can be done in one room—design with a standard CAD system, fabrication with the system, and testing," says Dooley. "The data tapes are secured and nothing has to come out of the room except the final parts."

Dooley also expects systems such as Lasa's to have an effect on the distribution business, which has been having a hard time adapting to semicustom technologies. "In addition to their traditional roles as the middlemen in the standard-IC business, many IC distributors have been active in setting up their own design centers to take advantage of the semicustom business," he says. They already make CAD tools available and take a fee on that; now distributors will be able to produce and sell prototypes. ☐


UNPERSON-ALIZED GATE ARRAY
LASOGRAPHY METAL PATTERN 1
SiO_2 DEPOSITION
LASOGRAPHY VIA ETCHING
LASOGRAPHY METAL PATTERN 2
LID ATTACHMENT
COMPLETED GATE ARRAY

2. STAGES. Uncommitted gate arrays in open-top packages are loaded into the QT-GA system for metal and oxide deposition.

ASIC; three miniaturized chambers for metalization, oxide deposition, and packaging; and a robotic system for moving the packaged circuit from chamber to chamber. Above the table is a bay containing a distributed microprocessor system, random-access memory, and tape drive for overseeing the operation.

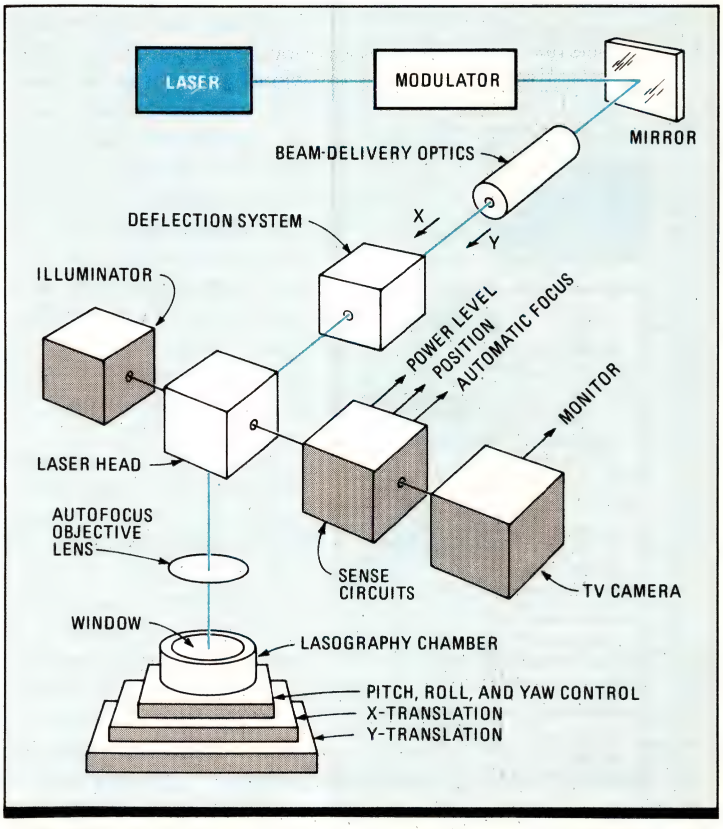
Achieving this combination of high throughput, ease of use, and compactness took Lasa almost two years and a number of design and process breakthroughs, says Dooley. New solutions had to be found in laser-beam control, robotics, image recognition, and low-temperature processing. Lasa engineers also had to tinker with process-equipment design, packaging and handling, and hardware and software control.

In the Lasa system, the fabrication process (see fig. 2) starts with uncommitted gate-array base wafers that have been taken through the aluminum metalization stage by conventional techniques. Metalization patterns defining uncommitted bond pads have been laid down and metal is left in the device contact areas, but otherwise the array remains uncommitted, explains Dooley. After evaluation of the wafer test pattern for device characteristics, the wafer is sawed, the dice are separated, optically inspected, and then mounted and wire-bonded in specially designed packages. These open-topped packages are then loaded into a carrier of proprietary design, which can hold up to 12 such parcels, and sealed in a nitrogen-purged plastic bag for delivery to the user.

On location at the user facility, all the circuit designer needs to do is take a design he has worked out on a standard CAD work station and load the design-topology data into the QT-GA in the form of a GDS-II formatted output on a magnetic tape cassette. There it is reformatted. An operator breaks open the sealed bag, inserts the uncommitted gate arrays into the cassette, and initiates action by pushing the appropriate location on a menu-driven, touch-activated screen.

"After the tape is loaded, all the operator has to do is tell the system how many parts are needed," says Dooley. The QT-GA then proceeds to direct-write the metal interconnects on each of the dice sequentially to create the appropriate design. The QT-GA handles the entire process under computer control. Its robotic system sends the gate arrays through the metalization chamber and into the final assembly area, where a ceramic lid seals the packages. Finally, the system delivers completed units at an output cassette location, all packaged and ready to test. No mask tooling or photolithography is involved. If the design is to be reused, the reformatted data will be stored on a 50-Mbyte disk drive.

Lasa's additive interconnection approach, in which metal lines are laid down by the laser, is opposed to the subtractive techniques of competitors Laserpath, Lasarray, and Elron in their own efforts to find a quick-turnaround way of fabricating gate arrays (see p. 69). In Dooley's opinion, the disconnect, or subtractive, approach is a dead end. "For one thing, the disconnect approach, in which the laser is used to cut the metal, causes a great deal of damage to the underlying silicon substrate if not done carefully," he says. "This places considerable restraint on throughput, especially at higher densities, and on yield, since there is a greater probability of damage as the number of cuts increases." And since the disconnect approach is precisely



3. OPTICS. Upping intensity of a focused 1-μm-diameter beam from an argon-ion laser raises local temperature wherever an interconnection is required.

HOW A WORRY TURNED INTO A COMPANY

In 1984, National Semiconductor Corp. made a financial decision that worried Dan Dooley, who was then a vice president and group manager at the company. "I had just come out of a management technology meeting where we had made a commitment to invest in excess of $100 million in a state-of-the-art fabrication facility for VLSI circuits," says the man who founded Lasa Corp. last year. "I was aghast. What we were talking about was an investment comparable to that needed to build a steel mill. I asked myself: 'How can we possibly expect to get a return on that kind of investment?' "

The answer he formulated to that question—"with great difficulty"—led to other questions. These, in turn, spawned an idea that ultimately became the basis for Lasa, the San Jose, Calif., company that Dooley founded with Leslie Burns, the founder of Xidex Corp. and former president of Burns Research.

The idea behind Lasa is that a market exists for a less expensive, less time-consuming fabrication technology, one that can be used for much smaller orders than would be practical at the $100 million facility National Semiconductor was planning. "The only way such [huge] investments pay off is with volume production in the hundreds of millions of units," Dooley says.

But such high-volume markets are getting scarce. The trend, in fact, is toward higher levels of integration, which implies ever more system- and application-specific circuits. That means fabricating fewer, not more, chips, with the average number of units per circuit type in the tens of thousands at best.

"I felt there had to be a fabrication technology or methodology that could impact this capital intensity," Dooley says. He saw particular potential in the fabrication of prototypes, whether for standard circuits, custom or semicustom designs, or gate arrays.

In all cases, he says, the problem is the same—generating working ICs quickly for testing and for evaluation in actual systems. The turnaround time is anywhere from six months to a year for standard circuit design, six to eight months for a custom design, and two to six months for a semicustom design. "And what happens if you get the circuit and it doesn't work in your design?" he asks. "You have two choices: either start all over again, or abandon the project."

DOOLEY: He figured there had to be a better way than $100 million fab facilities.

To find a way to create a system that can allow the fabrication of chips in hours or days, rather than in months, Dooley drew on the 10 years he spent as vice president of engineering at Precision Monolithics Inc., a Santa Clara, Calif., manufacturer of linear ICs. His work there with the laser trimming of linear ICs convinced Dooley that what he calls "lasography" was the key.

But Dooley decided against exploring the traditional approaches to laser use, in which a laser beam blows fuses and cuts interconnects. He felt that an additive, not a subtractive, technique was the ticket. There are problems with subtractive methods, he says: "Using lasers as a micromachining tool to cut patterns is inherently lower yielding, harder to control, and requires considerable expertise to operate."

Dooley mentioned the idea of an additive technique to Burns, a longtime friend. Burns's response, as Dooley recalls, was, "Funny you should mention that. I think there is a way."

The two put their heads together and came up with the idea of using the laser as an additive tool—one that would be used for laying down interconnect, rather than for cutting it. Ultimately, their brainstorm resulted in Lasa's new QT-GA (for quick-turn gate array), a laser-based chip-fabrication system (see p. 72).

With initial funding from Peter Sprague, chairman of the board of National Semiconductor, Dooley and Burns formed Lasa to build and sell QT-GA. Sprague's money was a personal investment; there is no official connection between Lasa and National. In the past year, the company has attracted about $12 million in additional funding in equity from a variety of private investors, mostly European.

Dooley views the QT-GA as the first member of a family of flexible manufacturing systems that are the antithesis of the rigid and increasingly costly semiconductor equipment now in wide use. While initial QT-GA sales will be to chipmakers, who are currently using the older, slower process, Dooley's long-term goal is to provide full-custom manufacturing capability directly to the users of standard, semicustom, and custom circuits.

The QT-GA system is in the beta-site stage now, being tested by semiconductor chipmakers. The company expects to be taking orders and delivering systems by the first quarter of 1988. A complete QT-GA system is expected to sell for $3 million. *–B.C.C* have a density range from 1,200 to 35,000 available gates, half that of the mask-programmable versions. "When the Elron micromachining laser technique is used with more traditional channeled arrays with predefined routing channels, densities are about 80% to 95% of a conventional finished array," Or-Bach says—and that's close to what mask programming can achieve. A second company with which Elron is working to develop specially modified arrays is Seiko. The family will be based on Seiko's SI6000, a 2-µm 6,000-gate channeled array, of which 5,500 to 5,900 will be available in the laser-based versions.

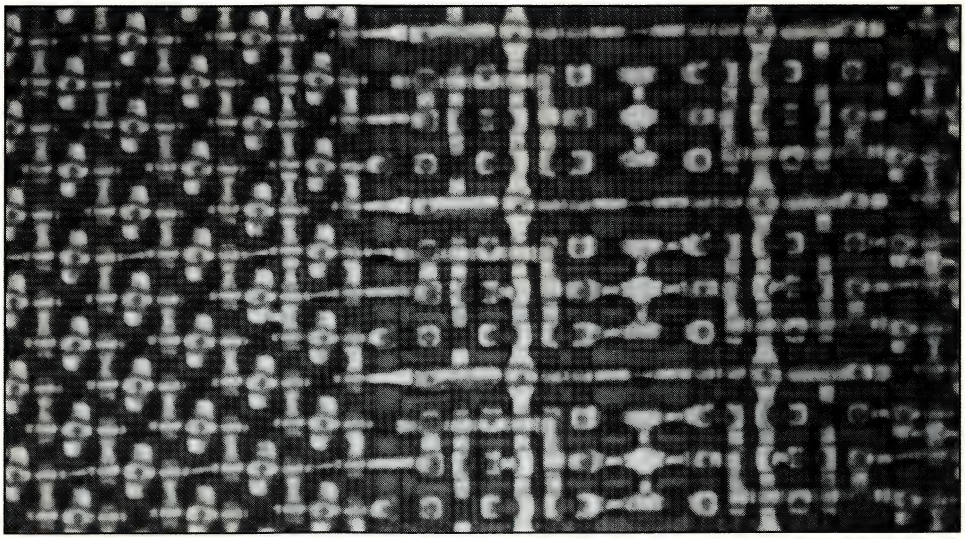
Unlike the Lasa approach (see p. 72), which uses standard blank gate arrays, the Elron laser micromachining technique can be used only with base arrays that have been modified by the circuit manufacturers in four key areas: input/output cells, the core logic array, the core routing, and the core interface with the I/O cells. In addition, the vendor must set aside a special calibration region on the die to calibrate the power of the laser. To design a circuit using the Quick system, the designer must also reconfigure his layout program using special software consisting of macrocells and a place-and-route routine supplied by Elron. This software reflects the modifications made to the base array.

In the VTI array, for example, the metalization of the I/O region was defined so that mask programmability was retained; each I/O location can be programmed as an input buffer, output buffer, I/O buffer, V_{dd}, or V_{ss}. In addition, care was taken to retain a pull-up resistor in each I/O cell to allow the output drive to be programmed to 2, 4, 8, or 12 mA.

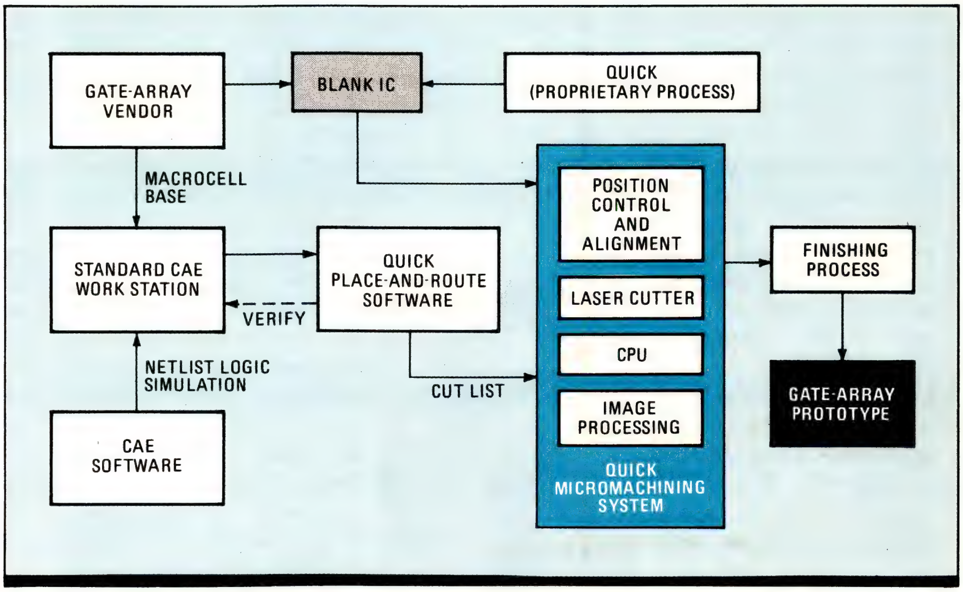
In the core area, the metalization was modified so that the Elron technique could be used in the interconnect scheme used in VLSI Technology's continuous-gate-array architecture, says Or-Bach. Unlike other channel-free schemes, in which the first- and second-level metals run in the same direction, the VTI approach runs the first layer of metal horizontally and the second layer vertically.

In order to increase the yield of good dice, modifications that Elron won't discuss also must be made in the core routing. In the case of the VTI continuous-gate-array architecture, this was particularly important since the company's parts include no predefined routing channels as do ordinary gate arrays. Instead, inter- and intramacrocell connections coexist in the same regions, with routing running over the top of active macrocells. To build a laser-programmable macrocell with this architecture, it was necessary to use up more area than with a conventional channeled gate array in the macrocell metal definition, says Or-Bach. The laser-written array ends up like a conventional array with alternating rows of macrocells and routing channels to connect macrocell wiring.

In the core-to-I/O-cell interface, additional modifications were made in order to bring all the



2. PERSONALIZED. Using a laser micromachining technique, a 2-µm, double-level metal, 2,500-gate CMOS array can be personalized by cutting interconnect in a predetermined pattern.



3. CUTTING. From a verified netlist, a data base is derived and modified by Elron software to produce laser cutting instructions.

IF YOU'RE WASTING TIME LOOKING FOR THE BROADEST LINE OF SMD® PASSIVES,

CUT IT OUT!

Mail to: Mepco/Centralab, Inc., Attn: Corp. Advertising
2001 W. Blue Heron Blvd., Riviera Beach, FL 33404.

Mail this coupon today to request your personal copy of the new Mepco/Centralab Surface-Mount Device Catalog, containing important design, performance and specifying data on America's broadest line of SMD® passive components:

- Tantalum and monolithic ceramic chip capacitors
- Aluminum electrolytic capacitors
- Thick-film and precision metal-film resistors
- Power resistors
- High-performance trimmers

Or ask for our valuable data book on leaded resistors and capacitors.

Please send me these specification guides:
☐ **1987 Surface-Mount Device Catalog**
☐ **Resistor/Capacitor Data Book**

Name ______________________
Title ______________________
Company ______________________
Dept./Div. ______________________
Address/MS ______________________
City ______________________
State/Zip ______________________

E 11/12/87

MEPCO/CENTRALAB
A NORTH AMERICAN PHILIPS COMPANY

THE ACTIVE LEADER IN PASSIVE COMPONENTS

®SMD is a service mark of North American Philips Corporation.

Circle 79 on reader service card

```
                          GROUND ZERO
            The game has begun ... the clock is ticking

> Request computer assistance ...

Computer online: WARNING! Your last mistake may have jeopardized the
                 mission. Examine your actions carefully. Time is of
                 the essence! I recommend using the performance
                 analysis function to determine the detonation timing
                 sequence - but that's only my opinion ...
> [illegible]

Total Emulation Time       :    [illegible]
Number of Event Occurrence :             16
Time of Event Duration     :    [illegible]
Average Time               :    [illegible]
Time Percentage            :    [illegible]
```

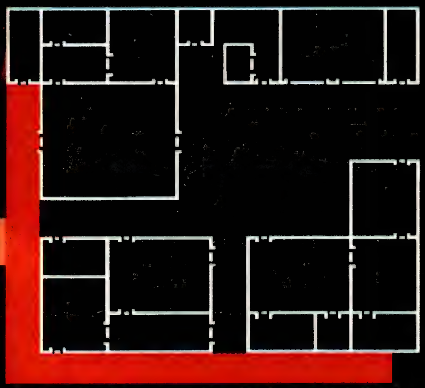


Diagram of Cramoisy Brigade camp. You'll need this to complete your mission.

Life's a game, or so we are told. And yet, when you're in a critical development mode and you encounter a buried "bug" it can seem like you're the victim. Now, ZAX challenges you to strike back by experiencing the ultimate in investigative tactics with Ground Zero! Ground Zero is an intriguing computer game that solicits shrewd thinking, lightning reflexes and sturdy nerves—plus the ability to face the sometimes unfavorable consequences of your actions.

Armed with your trusty ZAX in-circuit emulator, you'll parachute into the camp of the dreaded *Cramoisy Brigade*, a terrorist group plotting to assemble and then deploy a small, nuclear bomb. Your mission: Infiltrate the camp, discover the location of the bomb, dismantle it, and then retreat to safety.

With the map shown here you can begin playing Ground Zero, right now! Simply use your computer and modem and call the number below (8 bits/no parity/1 stop bit). Not only will you enjoy the challenge of matching wits against a cagey adversary, you'll learn how ZAX emulators can help you track down and destroy those hideous bugs that threaten to sabotage your development projects. Because after all, in the game of life the stakes are for real.

To play Ground Zero, call:

1-800-PLA GRD0

(in CA 1-714-474-1177).

No modem? Call 1-800-421-0982 (in CA 1-800-233-9817) for the Ground Zero game diskette or write ZAX Corporation, 2572 White Road, Irvine, CA 92714.

ZAX
Zax Corporation

STOP BY OUR BOOTH AT WESCON #2350

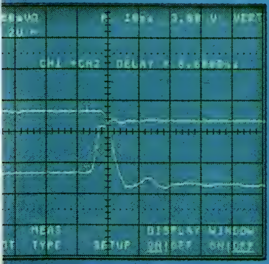
Circle 81 on reader service card

NEW TEK 2430A DIGITAL SCOPE. TODAY'S STANDARD.

(Opposite, left) The 2430A's onboard Help function ensures ease of operation for the new or infrequent operator. No more looking for that misplaced manual.

(Opposite, center) Join Save on Delta's pass/fail capability with Waveform Parameter's specific measurements.

(Opposite, right) AutoStep, a 2430A standard feature, lets you build and run automated or semi-automated test procedures from the front panel.

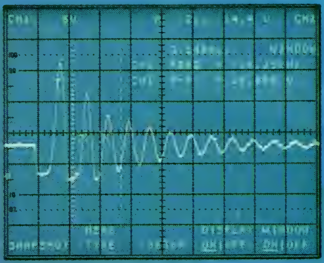


Now you can make automatic channel-to-channel propagation delay measurements with user-defined thresholds. Shown above is a propagation delay measurement from the mesial (midpoint) of the ECL rising edge on Channel 1 to the mesial point of a TTL falling edge on Channel 2. Display the waveform and read out the values on screen or over the bus.

The new, 150 MHz Tek 2430A is a superb combination of familiarity and innovation. You can digitize, view and store fast, complex signals with the proven performance of a scope built for solving tough design problems.

The 2430A with its familiar front panel and simple, one-level menus *drives* like the analog scopes you're used to. And powerful Local Test™ features put less time between you and results. Now you get scope setup in seconds, faster measurements and test procedures built *right from the front panel.*

The 2430A offers the highest performance for the price of any scope in its class. No other portable digital scope lets you capture elusive glitches as short as 2 ns at all sampling rates; automatically catch intermittent failures in babysitting applications using patented Save on Delta; and see waveform changes virtually *as they happen* thanks to the 2430A's high update rate.



Waveform Parameter Extraction allows you to make specific measurements on the windowed portion of a waveform. Here, frequency and peak-to-peak voltage measurements are made on two cycles of a damped sinewave. The cursors set the limits of the window.

Features	
Dual-Channel Bandwidth	150 MHz
Digitizing (Sampling) Rate	100 MS/s
Record Length	1K
Vertical Resolution	8 Bits
Time-Base Accuracy	0.001%
Peak Detection	Yes (2 ns)
Printer/Plotter Out	Tek HC100 Color Plotter, HP ThinkJet™, HP 7400 Series
GPIB	Standard (talk/listen)
Price	$8900

New Local Test features mean fast, accurate, automatic answers. Auto Setup takes the trial and error out of scope setup. Just one button sets up the 2430A to acquire and automatically display unknown input signals as you probe multiple points on a circuit. Auto Setup also simplifies your preparations for specific measurements.

With new Waveform Parameter Extraction you can characterize waveforms instantly: freeze 20 different waveform measurements on-screen at the touch of a button—or select four parameters for live update. Propagation delay between two signals is included.

And in just minutes with new AutoStep you can build a test routine from the scope front panel. Simply recall the sequence to debug a stack of prototypes.

It's all part of the most complete scope for product design. Features include extensive and easy-to-use triggering and direct hard copy output. Plus optional word recognizer and video triggering. On-screen operating instructions are at your fingertips—even when the manual isn't—with the 2430A's new Help Mode.

And you can take advantage of standard GPIB and off-the-shelf software to fully automate measurements and extend waveform analysis.

The 2430A's reliability is backed by a 3-year warranty. A variety of low-cost service plans can extend coverage even longer.

See the priced-right, standard-setting 2430A. Call your Tek sales engineer for a demo. For a free video demo or literature, or to find our sales office nearest you, call Tek direct:

1-800-426-2200

Circle 83 on reader service card

Tektronix

SECOND-GENERATION CLIPPER HITS A RECORD 50 MHz

The latest version of the RISC processor builds on the original architecture but uses finer line geometry and improved circuit design to boost performance

by Stan Runyon

The computing power that users increasingly are demanding for applications ranging from high-quality graphics to networking is coming. The 50-MHz, 32-bit Clipper C300 packs more power into a single three-chip module than any of today's microprocessors stuff onto a single chip.

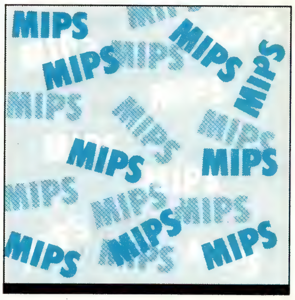
One reason for the Clipper's speed is its use of a Harvard architecture, which separates data and instruction streams, plus the inclusion of on-chip data and instruction caches, memory management, and a floating-point unit. However, the latest 32-bit contenders are closing in on Clipper. The Motorola 68030 and the National Semiconductor NS32532 contain all of those features but the FPU. Even so, the new Clipper 300 boasts the highest clock speed of all—50 MHz, compared with 30 MHz for the 532 and 20 MHz for the 68030 (with samples of a 25-MHz version due next month).

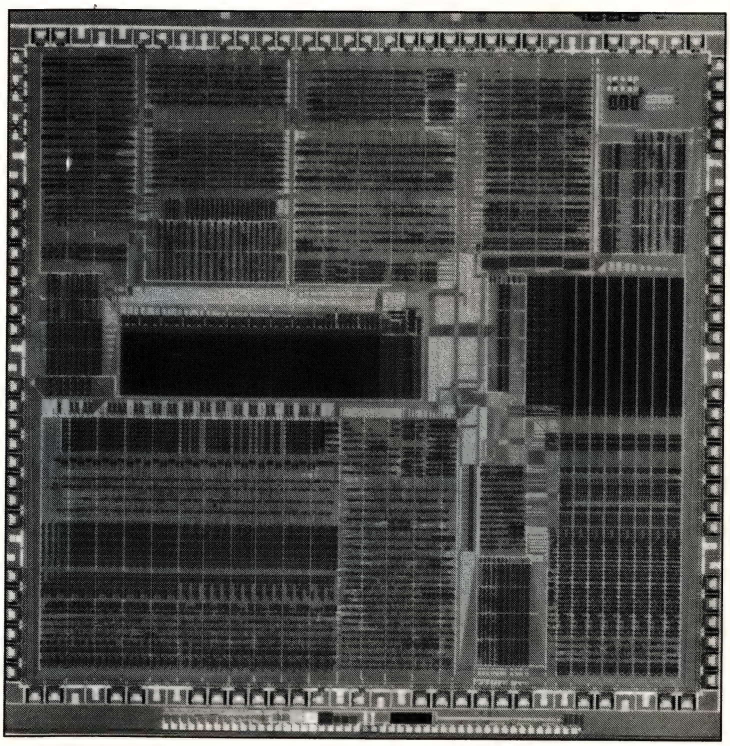
The C300 emerges just as Intergraph Corp. has finished taking over the Clipper operation from National Semiconductor Corp. (see p. 88). National sold the former Fairchild Advanced Processor Division because it felt it could not support two 32-bit-processor efforts.

The new Clipper gets its punch by building on the reduced-instruction-set architecture used for its predecessor, the C100. That architecture has been refined for higher performance. At the same time, compatibility was maintained between the two Clippers, so the new processor has the same range of software as its predecessor, with several compilers available and more coming. Key Clipper concepts, such as its cache memory scheme, are retained, but the C300 boasts finer line geometries and improved circuit design. The new Clipper also adds some new features, such as a new generator controlling the clock for the central processing unit, floating-point unit, and the two memory-management units. Tying the whole package together is an implementation of the Unix operating system.

The engineers at APD say that with the C300, the capabilities that until now were found only in sophisticated work stations can be built into a relatively inexpensive system that consumes a moderate amount of power and fits comfortably on a desktop. In the past, the circuitry to build such an engine required an entire board or even two. But with the latest silicon design rules and

TECHNOLOGY TO WATCH *is a regular feature of* Electronics *that provides readers with exclusive, in-depth reports on important technical innovations from companies around the world. It covers significant technology, processes, and developments incorporated in major new products.*





1. FAST CHIP. The 50-MHz Clipper's CPU builds personal computers that fit on desktops but have the power of work stations.

units. Running at an input frequency of 100 MHz, the clock generator also provides all system clocks and synchronizes multiprocessing applications. The input frequency is divided into individual 25-MHz and 50-MHz clocks to run the compute engine and other circuits.

Although clock speed is an important factor in determining effective system speed and instruction execution time, speed alone does not tell the full performance story; clock phases are just as important. For example, some 32-bit machines need not only a high-frequency clock but a multiple-phase one as well. Such a scheme can lead to control and skew problems, especially when interfacing to static RAMcache subsystems. A better method is the technique proven in supercomputers: a simple, single-phase, high-speed clock. Such a clock is easier to control and it delivers the same number of working edges as a multiple-phase clock.

The Clipper 300, like its predecessor, runs an implementation of Unix System V, release 3, called Clix. In the C300's implementation of Clix, extensive use is made of the engine's copy-back caching and overlapped virtual-memory mechanisms. For example, read, write, and execute access protection is enforced on a per-page basis, along with three different caching strategies—non-caching, write-through, and copy-back.

The C300's Clix operating system works in a distributed I/O system with an I/O processor. I/O drivers are provided to run the processor and pass messages to the main Clipper-hosted kernel. A distributed-line discipline can be implemented to increase terminal handling capability. ☐

For more information, circle 482 on the reader service card.

HOW TO MEASURE A PROCESSOR'S PERFORMANCE IN THE REAL WORLD

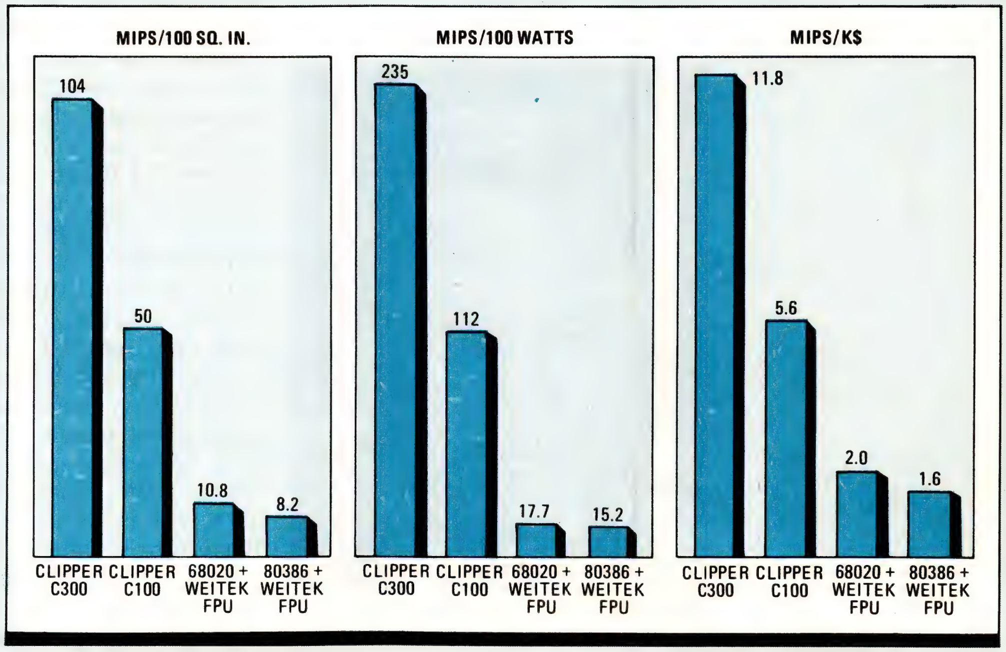
Most users of desktop computers are on the lookout for machines that offer more performance, but that desire must be tempered by the realities of a system's cost, size, power consumption, cooling requirements, and other factors. So the goal of computer makers is to design machines that deliver the high performance and still fit a user's budget, operating environment, and desk space. Figuring out the performance of any given system while taking into account all of these variables is hard to do. The Advanced Processor Division of Intergraph Corp. thinks it has come up with a way, using what it calls mips density.

Used alone, mips, or millions of instructions per second, provide only a rough measure of power. A better criterion is VAX mips, with a Digital Equipment Corp. VAX serving as the standard for comparison. The comparison is somewhat more precise in that case, since it provides a constant to measure against. But VAX mips still only measure sheer speed.

Mips density is a far more precise gauge than either raw mips or VAX mips. It accounts for performance, or efficiency, with respect to physical size, power consumption, and cost. The accompanying figure compares the mips-density performance of four 32-bit processors: the 33-MHz Clipper C100, the 50-MHz Clipper C300, the 25-MHz Motorola 68020, and the 20-MHz Intel 80386.

The first panel of the figure shows mips performance as a function of circuit-board area. Obviously, the more computing power compressed into a given area, the more dense the machine. With the C300 module occupying just 12 square inches of board area, it delivers considerably more computing power than competing processors, which require more board area to accomplish the same functions. The size of the compute engine is critical because it affects the number of boards in the system. Too many boards devoted to the processor means fewer expansion slots in the machine.

The C300 also provides about 13 times more processing power than a 68020 (second panel) for every watt of power consumed by the system processor. Excessive power dissipation can drastically alter a system's potential location in an office, its reliability, or its cooling requirements. Finally, the C300 outdoes its competitors at the basic level of cost. It is more cost-effective than the other computation engines by six times or more.



CAD/CAM market share—from 15.1% last year to 14.1%, primarily because a shortage of Clipper chips prevented Intergraph from shipping more work stations and systems, says Charles Foundyller, president of Daratech, Inc., a Cambridge, Mass., market research firm that closely tracks the CAD/CAM market. He expects Intergraph to grow perhaps 3% this year, to $623 million. That still ranks Intergraph second to IBM, with a 25.8% share, according to Foundyller.

The chip shortage is a thing of the past, according to Meadlock. Fujitsu Corp., which fabricated Clipper chips for Fairchild, continues to do so for Intergraph APD. Meadlock says Intergraph consumes about 1,000 sets a month, "and Fujitsu is building more than we can consume; production isn't a problem."

INTERGRAPH IS THE INTEGRATION ARM

Meadlock is quick to point out that the APD acquisition isn't a veiled move into the semiconductor business for Intergraph. "We will be the integration arm of APD, but we won't be in the semiconductor business," he asserts. The division will remain where it has been, in Palo Alto, Calif., under the same management team Fairchild had. That team is headed by Howard Sachs, vice president and general manager, who reports to Meadlock but sets his own goals for the division.

To some extent, however, Intergraph will be competing in the overall work station market, as opposed to its current business of selling work-station-based solutions, complete with software, for CAD/CAM and mapping applications. Meadlock says that Clipper now becomes part of a larger family of products—Clipper chip sets, modules and board sets, along with Intergraph work stations for application development—all of which will be sold through APD.

Daratech's Foundyller sees some risks in Intergraph's shifting its focus. "They'll need to alter their marketing strategy" for that part of their business, Foundyller says, and there's a risk that the company's management talent could be spread too thin.

Meadlock, however, says that Intergraph is committed to making APD and Clipper succeed in the global market. "Clipper and APD lost at least a year in the market because of the uncertainty that surrounded Fairchild. That's in the past and we're now setting up an APD sales force. The division has a marketing organization, which we acquired, but we didn't acquire their sales people."

Meadlock says 10 new sales people will be hired. They will make up a dedicated sales force for the U. S. and Europe that is completely separate from Intergraph's direct sales force for graphics systems.

While chip supplies and a dedicated sales force are challenges that have been addressed, a remaining problem is getting work station and system companies to commit to Clipper in the aftermath of the uncertainty about Fairchild's viability and the Intergraph Clipper acquisition. Meadlock cites three U. S. companies outside Intergraph that are using Clipper: Maxim Inc., a Colorado Springs, Colo., supplier of PC add-in boards; Opus Systems Inc., a Cupertino, Calif., vendor of PC XT and AT add-in cards that enable MS-DOS and Unix to run simultaneously on a PC; and Zaiaz International Corp., a Huntsville, Ala., supplier of Unix add-in boards for PC ATs. In Europe, Spea Software AG, a West German start-up, uses Clipper in add-in boards that convert PCs to work stations (see p. 90).

That's not exactly a Who's Who listing, but Meadlock says he's seen a list of other companies (which he won't divulge) who are candidates for Clipper. They include manufacturers of VMEbus-based, single-board computers, embedded avionics and data communications hardware, plus other Unix-based systems. "A wide variety of companies had decided to go with Clipper, some of whom backed away until the acquisition was completed.

CLIPPER SAILS ALONG. The advantages in speed that Intergraph's work station gets from using the Clipper cannot be derived from any other standard microprocessor.

systems being added each month. "That's the market we're after and we think we can persuade from 2% to 3% of the 140,000 users and 10,000 newcomers per month to convert to a Clipper processor," Seng says. "We are aiming at 3,000 to 4,000 installations a year."

So far, Spea has the European market to itself. It's the only company selling Clipper-based equipment, although a few others have started experimenting with the Intergraph processor. To better exploit its position, Spea is considering setting up before the end of this year a subsidiary in the U. S., "the world's most important market," as Seng sees it.

It already has software available for a U. S. push. For example, one of the American market's most important CAD software packages, Autocad from Autodesk Inc. of Sausalito, Calif., has been ported by Spea to the Clipper board. The latest version of Autocad, announced early this month, is expected to run six to eight times faster on a Clipper-based machine than on one using the Intel 386.

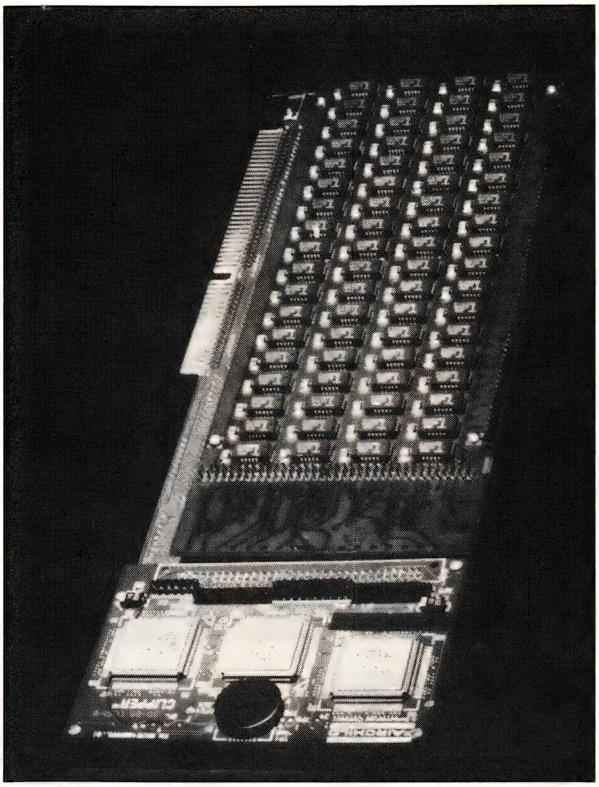
And based on its past performance, Spea could reap sizable rewards in the U. S. Founded in January 1986, Spea originally developed and sold graphics controllers, 32-bit Unix cards, and computer-aided-engineering software. It was not until this summer that it branched out into selling Clipper-based boards for upgrading personal computers to work stations. Business boomed, with sales hitting about $560,000 a month, up from $110,000 for the entire first half of 1987. They should reach $780,000 a month toward the end of this year, Seng figures.

Actually, success came a bit late to Spea, Seng says. The company's sales curve could have started its steep upward climb a few months earlier, if Fairchild had been able to deliver the Clipper processors as originally scheduled. Also, when the first 25-MHz versions finally became available last summer, the Starnberg company had to eliminate a few bugs, mainly compiler and assembler errors, from the devices. "We are now happy with the product," Seng says.

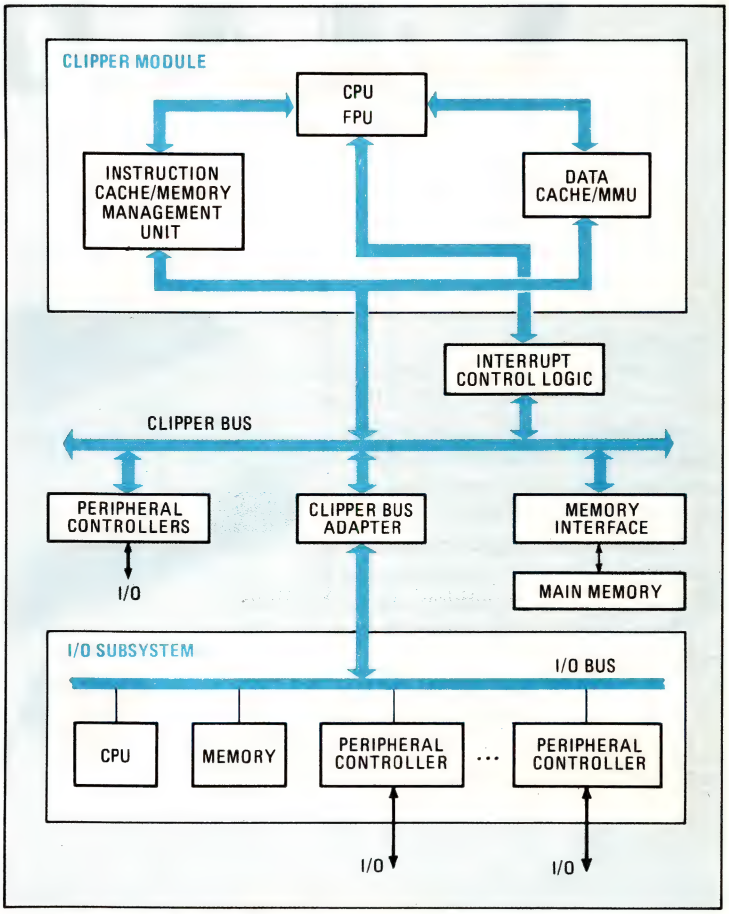
Problems also delayed the introduction of boards and systems using the Clipper's 33-MHz version. These were initially plagued by the development of excessive heat, a problem Spea has meanwhile solved by proper equipment cooling. "So it's we who have helped make the Clipper error-free and start a market for it in Europe," Seng says. Boards and systems using the 33-MHz version will be available early next year.

For continued success, Spea is banking on steady deliveries of the Clipper, now that Intergraph Corp. in Huntsville, Ala., has bought the Fairchild Semiconductor Corp. division that developed the processor. And as for the latest Clipper, the C300, Seng says he can hardly wait. He hopes to become the first company to offer 300-based boards. □

For more information, circle 484 on the reader service card.



SCREAMER. Intergraph's Clipper lets Spea build a powerful one-card accelerator that turns PC ATs into 5- to 8-mips machines.



WHAT MAKES IT TICK. Spea's accelerator board is partitioned for high throughput, in part because of independent buses.

We've made a Very Large Scale Investment you need to take a close look at.

Right now in the electronics R&D industry, compound semiconductors such as gallium arsenide and mercury cadmium telluride offer great promise for the future. The same is true of computer architecture, parallel processing, integrated optics and electronic reliability.

In Georgia, both industry and universities are conducting advanced research in all these critical areas. In fact, Georgia Institute of Technology ranks first among U.S. public universities in the amount of engineering R&D expenditures. It recently won a $21.3 million Army contract to develop ultra-fast parallel processing systems using VLSI design research for the Strategic Defense Initiative. And no university grants more undergraduate E.E. degrees.

Today, with support and advice from industry, our state is investing $30 million to expand electronics research through Georgia Tech's inter-disciplinary Microelectronics Research Center. This unique public/private effort is part of the Georgia Research Consortium; and it's just one of several important investments we're making in the future of Georgia's electronics industry.

In the last three years, we've also allocated more than a billion dollars in new educational efforts, primarily in our Quality Basic Education program—the most comprehensive educational package any state has ever undertaken. We've invested in new buildings, new courses, new equipment and new instructors for our statewide vocational technical schools. Our Quick Start program, one of the nation's first, remains a leader in training new employees for industry.

Put all that together with our lower than average cost of living, mild weather, relaxed lifestyle—and you've got an overall business climate that has earned Atlanta a spot in John Naisbitt's Top Ten listing of places to start a company.

Lately a great many firms have agreed with that impressive assessment. Just since 1978, 255 electronics, telecommunications, computer software, aerospace and instrumentation companies have opened their doors here. Employment in those companies has grown more than 25% in the last two years, and the 100 largest firms have reported revenue gains averaging 42% for 1984.

But all these facts are still only part of our Very Large Scale Investment in the future—if you'd like to see even stronger data, just send in this coupon. Or call Bob Lewis at 404-656-3575.

For free information write to:
Georgia Department of Industry and Trade, Dept. EL, 230 Peachtree Street, N.W., Atlanta, Georgia 30303.

NAME ____________________

TITLE ____________________

COMPANY ____________________

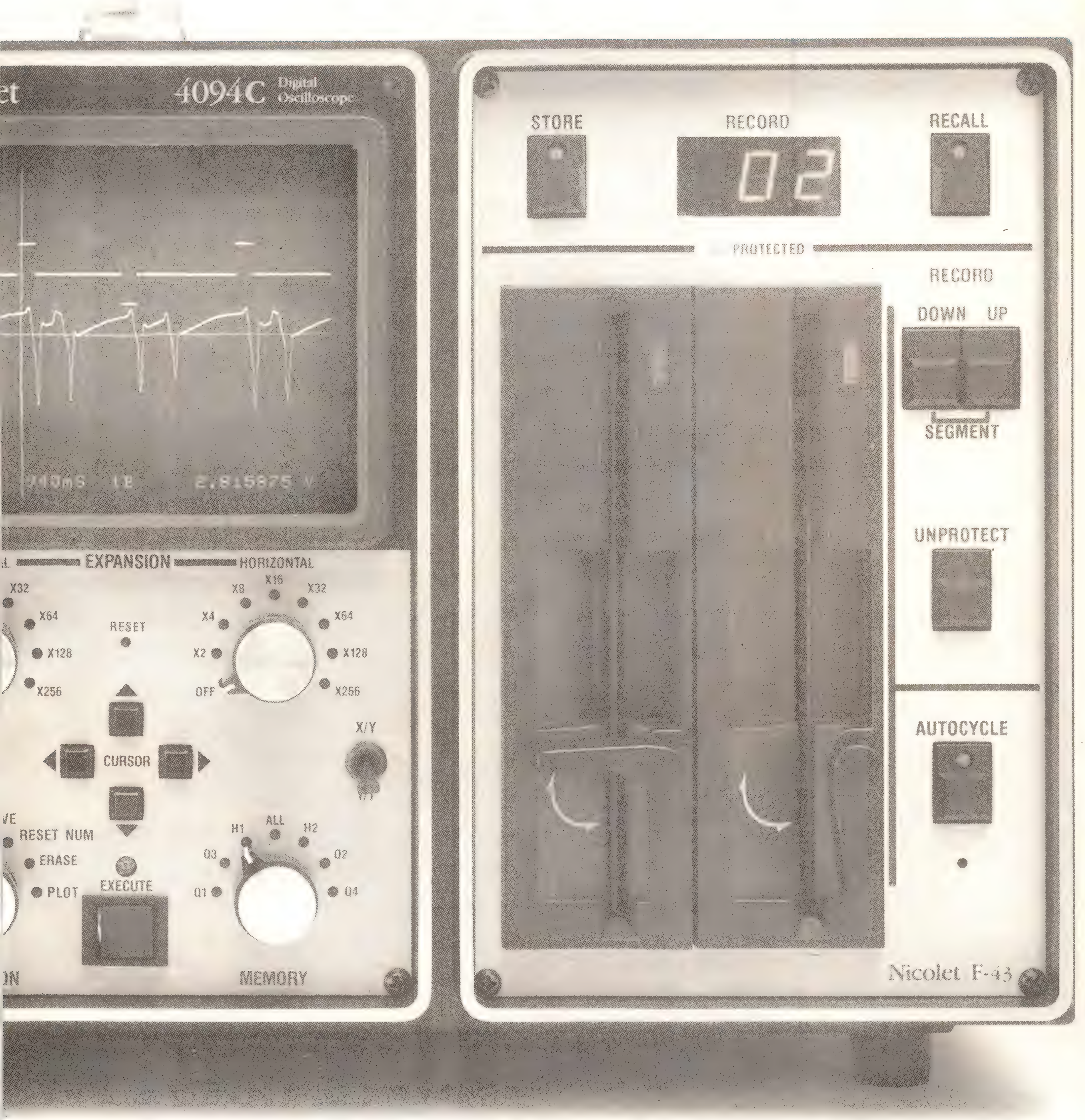
ADDRESS ____________________

____

GEORGIA
The State
of Business Today

Circle 93 on reader service card

Nicolet Digital Oscilloscopes



Circle 95 on reader service card

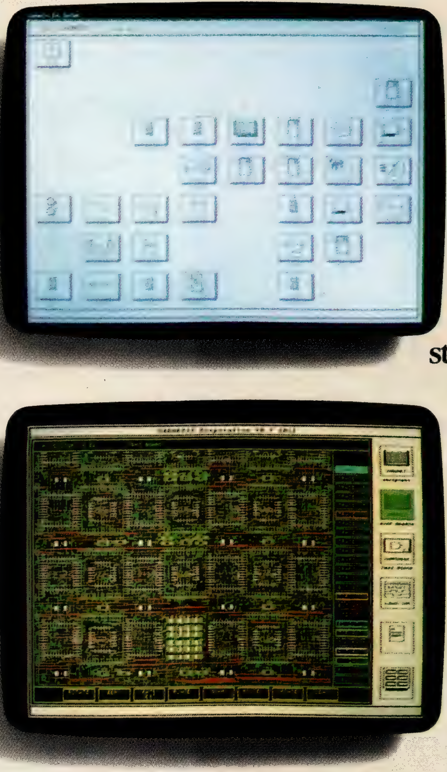
ated today's gn tools. Now, we're rrow's. Concept 3.

Cadnetix has been looking into the future. Two years of research, development and strategic planning have culminated in a significant breakthrough in electronic design. Concept 3 is more than a standard platform from Sun Microsystems.® It's a whole new world of system design capabilities.

Emerging technologies demand a new set of design solutions. Advances in ASICs, high-frequency components and fine-line design are creating new challenges in engineering, design and manufacturing. A new level of CAE/CAD/CAM sophistication is required to get the job done, and stay competitive. Companies must have even tighter integration between engineering, design and manufacturing, plus open access to all the equipment that's needed to produce a product quickly.

That's why we developed Concept 3, the convergence of advanced design tools and open systems, and more. We've redesigned our tools from the database up, to meet your design future. Concept 3 is Flexible Field™ routing and high-frequency design. It's a global data structure designed to handle off-grid components. It's RISC-based simulation acceleration, extraordinary ease-of-use and a seamless data path from schematic to manufactured product.

Concept 3 is also Cadnetix and Sun. Front-to-back system design on an industry-standard workstation. It's a perfect fit. Both companies have established reputations for delivering advanced technology. Both are committed to open systems and networking. And both base their products on industry standards such as UNIX,® Ethernet and NFS.™



Now you get ease-of-use, state-of-the-art design, and a UNIX workstation that runs all Sun third-party software. We take full advantage of an open environment, so that Sun Workstations can share the network with Cadnetix systems and DOS PCs. It's the best balance of cost and performance available. Moreover, every workstation has access to the advanced capabilities of multiprocessor, RISC Engines for accelerated simulation, physical modeling or accelerated 100% routing.

The Cadnetix CAE Sun Workstation is a complete desktop solution, with tools for schematic creation, analog and digital simulation and ASIC design. The CAD/CAM Sun Workstation includes Cadnetix' industry-famous tools for PCB layout, routing, tooling, assembly and test. Cadnetix front-to-back CAE, CAD and CAM eliminate netlists, data conversions and design to manufacturing hold-ups. It's a level of integration unmatched in the industry.

Take a look at Cadnetix Concept 3. Because it isn't enough to solve today's system design problems. You have to be ready for tomorrow's.

CADNETIX

Because tomorrow's design problems demand solutions today.

Concept 3 and Flexible Field are trademarks of Cadnetix Corporation. Sun Workstation and Sun Microsystems are registered trademarks and NFS is a trademark of Sun Microsystems, Inc. UNIX is a registered trademark of AT&T.

Circle 97 on reader service card

MOTOROLA'S ARRAYS HIT A NEW HIGH: 80% GATE UTILIZATION

They do it with triple-metal CMOS and flexible power-bus routing

by J. Robert Lineback

Three levels of metal interconnection and a new power-bus routing scheme are helping Motorola Inc. redefine the meaning of high density in CMOS gate arrays. No longer must arrays hog huge amounts of real estate or boast a gargantuan gate count to deliver a lot of usable logic.

That is the message behind a new family of triple-metal, 1-μm CMOS arrays from Motorola (see fig. 1). The new series promises up to 80% utilization of logic on channelless master slices ranging from less than 6,000 total gates to over 100,000. Comparable 100,000-gate arrays from other companies deliver at most 50,000 usable gates.

The ability to program gates with all three metal layers and the use of a flexible power-bus routing scheme, say managers at the Application-Specific Integrated-Circuit Division, result in more efficient use of logic compared to competing channelless architectures using the third level of metal only for power distribution. This makes for more efficient use of chip real estate. "High density in our book is not just a whole bunch of raw gates on a chip," says John Carey, product marketing manager at the Chandler, Ariz., division. Other recent sea-of-gate product introductions offer over 200,000 gates on larger die sizes [*Electronics,* Oct. 29, 1987, p. 55]. "High density in our definition is 1,097 μm^2 per gate, which comes about through the triple metal routing capabilities."

The new family sports typical internal gate speeds of 300 ps on fanouts of 2 pF at 25° C and 5 V. It also has a flexible bond-pad structure around the periphery that can accommodate either wire bonding or high-pin count tape-automated bonding. Wire bonding offers up to 300 input/output pads having a pitch of 5.6 mils. The current TAB will support a total of 460 ground, power, and I/O pads on a 4.0-mil pitch.

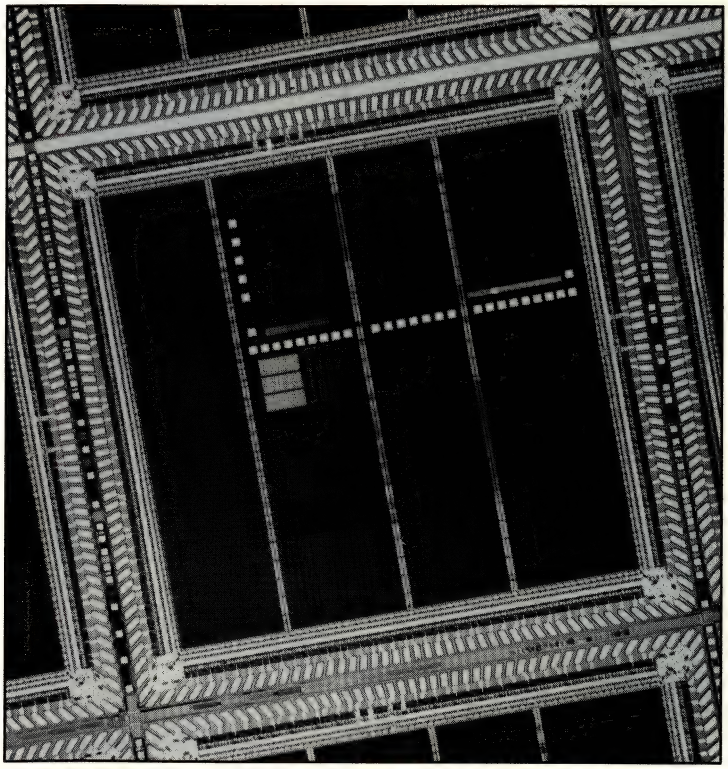
The new HDC family will consist of 10 master slices, spanning from 5,670 to 104,832 total gates. The total die size of the smallest HDC5000 array is 159 mils on a side, and the biggest family member measures only 483 mils on a side. Other channelless arrays in the 100,000-gate range are much larger—as much as 597 mils on a side.

Initially, Motorola's ASIC Division is offering three sea-of-gate master slices for 16,000-gate arrays. Joining those three family members in the first quarter of 1988 will be arrays for gate implementations totaling 5,000, 8,000, 12,000, 25,000, 45,000, 62,000, and 80,000 gates.

Motorola product managers estimate per-unit prices will fall in a range between \$0.003 and \$0.008 per usable gate, depending upon package selection and array density. Nonrecurring engineering charges of between \$35,000 and \$250,000 will be placed on array designs ranging from 16,000 to 100,000 gates. Motorola is launching the series with 12-to-14-week turnaround cycles, from the time customers sign off on a design to the shipment of the first prototypes. The turnaround times are expected to shorten during the coming year.

The HDC series, also dubbed the "Max" family, are made from a process Motorola calls TRIM, which not only stands for triple-level metal technology but also refers to the process's ability to cut the silicon real estate usually associated with large semicustom logic arrays.

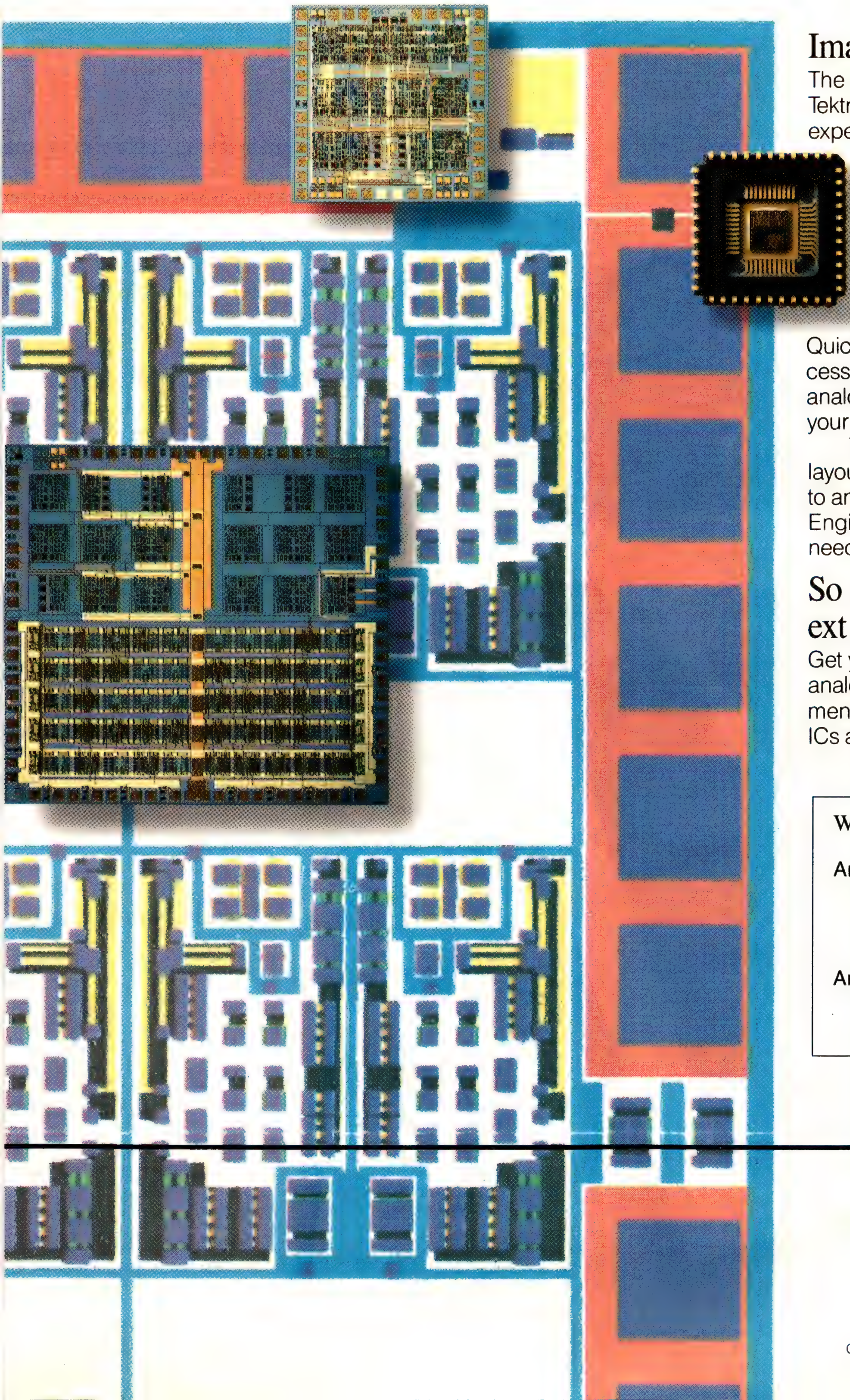
A key feature of Motorola's HDC gate array



1. TRIPLE PLAY. Motorola's new Max family of high-density CMOS gate arrays features three metal layers and offers up to 100,000 total gates.

TEK MICROCIRCUITS

Custom performance, QuickChip™ turnaround.



Imagine.

The performance, speed and reliability of Tektronix bipolar ICs. Plus technical expertise in analog design second to none. Together they cut a direct path to market without cutting quality for your new products.

That's Tek's QuickCustom™ approach.

It begins with a family of seven QuickChip arrays to start the design process. Within weeks you have analog or analog/digital ASIC's in hand that meet your requirements.

Tek delivers the training, graphic layout and simulation tools, plus access to an experienced Tektronix IC Design Engineer. You get the performance you need at QuickCustom prices.

So call (800) 835-9433 ext. 100.

Get your hands on the semi-custom, analog and analog/digital IC development resources you'll need. Full custom ICs are also available.

WHAT ARE QUICKCHIPS?

Analog QuickChip family:
- ☐ 150—524 NPN Transistors
- ☐ f_T typical to 6.5 GHz at 15V or 2.5 GHz at 65V.

Analog/Digital QuickChips:
- ☐ Gate propagation delay: 400 ps
- ☐ Digital function library

Tektronix®
COMMITTED TO EXCELLENCE

Circle 101 on reader service card

Copyright ©1987, Tektronix, Inc. All rights reserved. ICO-002A.

ABOUT THE SPEED AND RELIABILITY OF TOSHIBA OPTO COUPLERS.

Among animal lovers, white thoroughbred Arabs are regarded as the finest example of the Equus genus. Toshiba opto couplers share more than just hereditary reliability and outstanding speed with these noble creature – for instance, the 6N series with a switching speed of up to 10 MB/sec. They also have the colour white in common – Toshiba's white moulding ensures a high current transfer ratio and high isolation voltage.

In other areas, too, Toshiba semiconductor technology is setting standards: from memories via GTR modules, LED lamps, CPU's, custom IC's, bipolar IC's and transistors down to CMOS logic. Tell us about your problems and needs. You won't have to wait long for an answer.

☐ Please send me detailed information on Toshiba opto couplers

☐ and on ____________

☐ I wish to arrange a visit from one of your engineers, without any obligation on my part.

Name: ____________
Company: ____________
Telephone: ____________
Industry: ____________
Address: ____________
____

In Touch with Tomorrow

TOSHIBA

hiba Europa (I.E.) GmbH, Electronic Components Group, Hansaallee 181 – 185, D-4000 Düsseldorf 11, West-Germany, Tel. (0211) 5296-0, Telefax: (0211) 5296-404 · Büro München,
bellastraße 33, D-8000 München 81, West-Germany · Stuttgart Office, Eltinger Straße 61, D-7250 Leonberg, West-Germany · Toshiba U.K. Ltd., Toshiba House, Firmley Road, Frimley, Camberley,
-Surrey GU 16 5JJ, England · Toshiba Europa I.E. GmbH, Paris Liaison Office, four de bureaux de Rosny 2, Avenue de Général de Gaulle, F-93118 Rosny Sous Bois, France · Toshiba Electronics
iana s.r.l., Centro Direzionale Colleoni, Pallazzo Andromeda Ingresso 1°, I-20041 Agrate Brianza Milano, Italy · Toshiba Electronics Scandinavia AB, Box 438, S-101 25 Stockholm, Sweden.

Circle 171 on reader service card

NOW, A WAY TO DO ON-THE-SPOT CHECKS OF IC DESIGN CHANGES

SDA Systems' tools no longer need verify the entire design to check out one change

by Jonah McLeod

A powerful new version of SDA Systems' design-verification tools promises designers of full-custom integrated circuits capabilities they've never had before—capabilities that can cut significantly the time and effort spent on verification. Now designers can interact with the verification tools, adding changes or making corrections and then checking immediately to see if they work. They can also verify designs the same way that they build them—hierarchically, adding levels of complexity and verifying the design at that level, rather than waiting while the tools break each level down to its basic transistors and check the design at that elementary level.

Until now, checking a circuit layout to see that it observes the design rules of the process technology to be used for that circuit, and that it conforms with good design practice, was done mostly on large mainframe computers and was run in batch mode. The task is computation-intensive and time-consuming because the design must be reduced to elementary individual transistors to perform the analysis. Even the newer design-verification tools that can run on work stations evaluate the entire design for every change. Doing so is not only time-consuming, but precludes interaction—the designer cannot simply make one change to a design and check only the change, but must verify the whole design all over again.

The four tools in SDA Systems' kit include new versions of PD (for physical design) Check, PD Extract, and PD Compare. The upgraded tools allow the designer to extract a network description from his layout data base and compare it with the original schematic to detect any differences much more automatically than do other tools. The San Jose, Calif., company also has added a fourth, completely new tool, ERC, for electrical rules check. The tools are all tightly integrated, using a common data base called Framework [*Electronics*, June 25, 1987, p. 57].

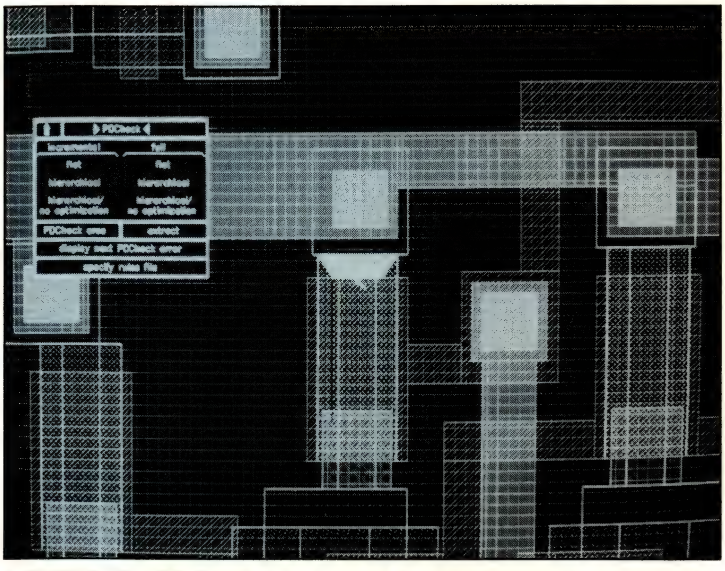
The revised PD Check offers capabilities not provided by competing tools. Using it, a designer can, for the first time, perform an incremental, hierarchical check of his layout.

That means he checks each step of the design as he gets to it. The system keeps track of changes between incremental checks, verifying only additions to the circuit rather than checking on the whole circuit. An hour of design work can be verified in a minute. "Not only is the check performed very quickly, but the designer catches his mistakes at the earliest stage in the process," says Dwight Couch, product marketing manager at SDA Systems. Checking the design as he goes saves the designer the typical two-month verification at the end of his design cycle.

The hierarchical verification capability is a logical extension of the way designers work. "Designers are already using hierarchical design methods," says Couch. "They should also verify their designs hierarchically. It is just a much more efficient way to check a design." In practice, it means, for example, that once the tools verify a circuit—say a 4-bit counter—every occurrence of the counter thereafter in the design hierarchy need not be reverified. PD Check can also verify designs at the "flattened" or transistor level, if necessary.

"This tool currently provides the fastest throughput of any design-verification system currently available, even before this latest release," says Couch. And by using new algorithms, the speed of operation of the latest version has been doubled. In addition, the amount of disk space the program takes up has been cut in half, making the program much more efficient when running on a work station.

In operation, PD Check shows the designer, with a flashing indicator on his work-station



1. CHECK. The PD Checker tool allows fast hierarchical and incremental checking of complex circuits interactively.

Gates Energy Products has purchased GE's Battery Business Department, making us the world's largest source of sealed rechargeable batteries.

What does this mean to you?

That Gates is dedicated to providing you with the best rechargeable batteries in the world.

Gates now has the technology and resources to offer the largest selection of rechargeable batteries including nickel cadmium, nickel hydrogen and sealed lead batteries–from .065Ah to 300Ah.

Leading the technological advancements at Gates is our new GEMAX™ Series of nickel cadmium cells. These cells are providing more run time and maximizing power delivery in all product applications by incorporating higher capacities and lower internal resistance.

As a result of GEMAX technology, Gates now offers the world's highest capacity, production-volume Sub C cell at 1.4Ah (1-hour rate). And more advancements are on the way.

Our commitment to supply batteries tailored to your specific applications is yet another aspect of our determination to make sure that Gates batteries are superior.

No other rechargeable battery company in the world is taking such dramatic steps to perfect and expand their rechargeable battery products as the new Gates. It's time you discovered the difference.

For more information worldwide, contact one of the Gates Regional Sales Offices listed below.

Gates Energy Products

WESTERN U.S.
4063 Birch St. #130
Newport Beach,
CA 92660
(714) 852-9033

CENTRAL U.S.
2860 S. River Rd.
Suite 401
Des Plaines, IL 60018
(312) 827-9130

EASTERN U.S.
1 Prestige Dr.
Meriden, CT 06450
(203) 238-6840

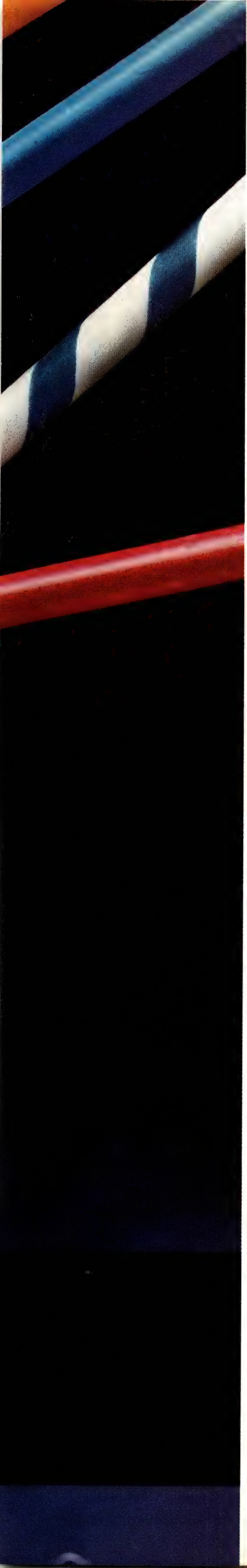
SOUTHERN U.S.
1835 Savoy Dr.
Suite 200
Atlanta, GA 30341
(404) 458-8755

PACIFIC AND ASIAN
3706 A, Shun Tak Centre
200 Connaught Rd. Central
Hong Kong
011-852-5-403073

EUROPE
Units 12/13
Loomer Rd. Industrial Estate
Chesterton
Newcastle-under-Lyme
Staffs. ST5 7LB, Great Britain
011-44-782-566525

©1987 Gates Energy Products, Inc.

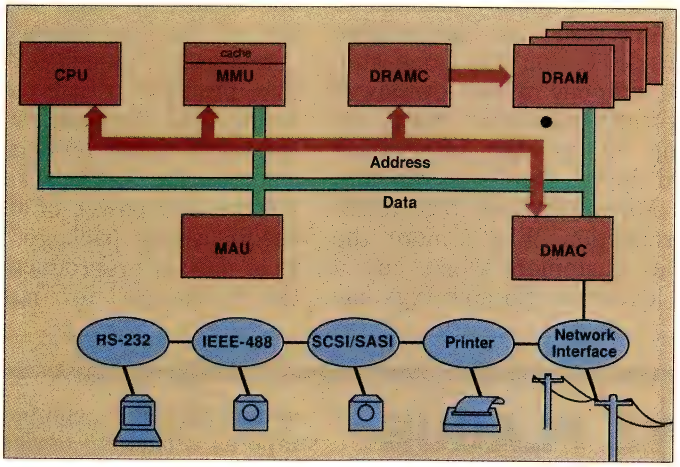
Circle 107 on reader service card



The first 32-bit Microprocessor with a 20 to 30 MHz systems capability.

It's the no-wait-state of the art in multiuser, multitasking performance—AT&T's third generation chip set—the WE® 32200 Microprocessor and peripherals.

A reflection of AT&T's commitment to the microprocessor marketplace, this is the first chip set to offer true systems-level solutions for board designs in the 20 to 30 MHz range. A powerful combination of a 32-bit CPU, peripherals, UNIX® Operating System, 1.0 micron full CMOS technology, and an application software range that just won't quit.



AT&T's newest system design offers a cache memory that runs at 20 to 30 MHz.

The ultimate engine. Developed by AT&T, the WE 32200 CPU doubles the throughput of the AT&T WE 32100 Microprocessor and is upwardly compatible. Performing at 6 to 8 MIPS, it has 32 32-bit registers, 256-byte instruction cache, and includes operating system and high-level language support.

But with a system so advanced, the heart is only the start of it.

AT&T's WE 32201 Memory Management Unit (MMU) incorporates an unprecedented 4 Kbyte on-chip data cache, supports zero-wait-state virtual accesses at up to 30 MHz, and greatly reduces CPU overhead. This MMU has a variety of protection mechanisms to maintain system integrity. It is a 400,000-transistor testimonial to AT&T's technological leadership.

AT&T's WE 32206 Math Acceleration Unit (MAU) is today's fastest floating-point co-processor that meets the IEEE 754 standard. It performs at 3.5 MWhets/sec.

Add to this a 32-bit DRAM Controller that supports 1 MEG DRAMs and a DMA Controller with a super-high transfer rate: 14 Mbytes/sec. memory to memory at 18 MHz.

The final thirst quencher. Upwardly compatible with the WE 32100 CPU, the WE 32200 Microprocessor chip set runs over 1,500 application programs, with more on the way. And AT&T offers all software development tools—including UNIX Operating System with optimized compilers for C, Fortran, Pascal, BASIC, and Cobol.

For more on how AT&T's WE 32200 Microprocessor chip set can help you bring top-line computer solutions to the multiuser/multitasking marketplace, call **1 800 372-CHIP.**

In Canada, call (collect) **215 266-2975 or 2977.**

In Europe, call AT&T Microelectronics in Munich, Germany at **089/95970.**

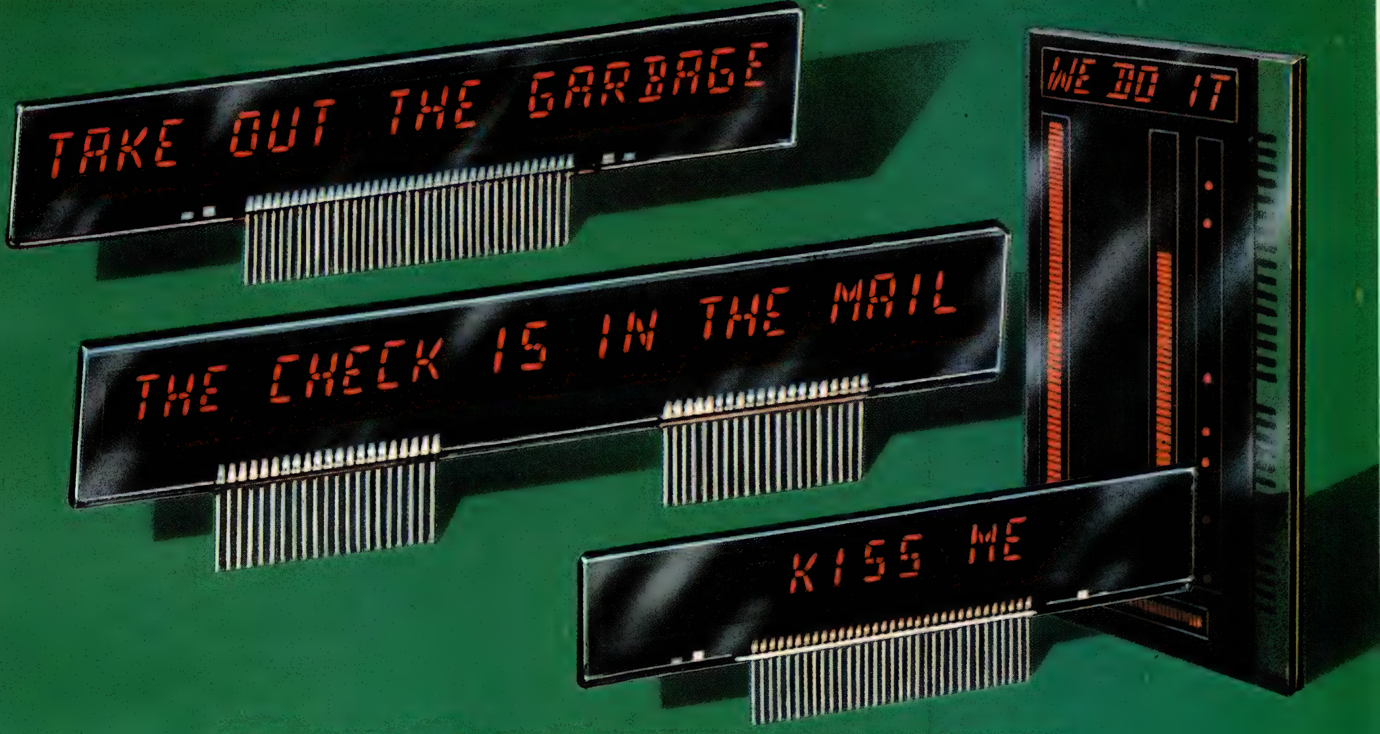
Or write to AT&T, Dept. LT, 555 Union Blvd., Allentown, PA 18103.

©1987 AT&T

AT&T

The right choice.

Circle 109 on reader service card

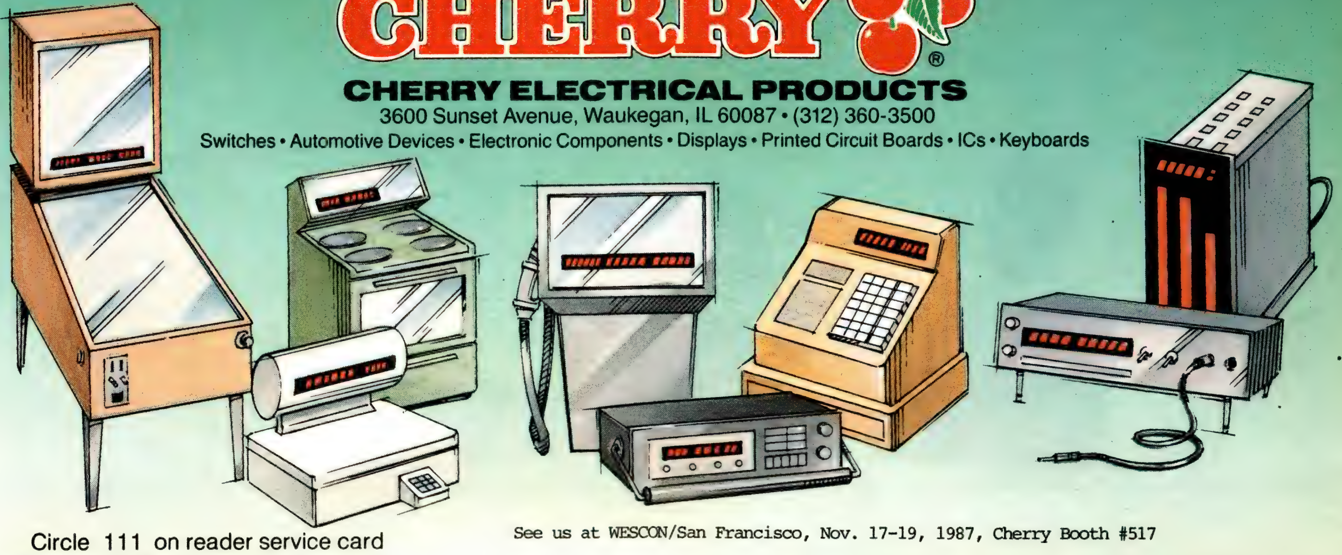


They'll get your message with our Gas Plasma Displays

If it can be printed on paper
we can apply it to glass... with
• Uniform color, high brightness
for easier readability • Excellent
wide viewing angles and
multiplexibility • Long life •
Direct PC Board mounting • Custom
display capability • Your message
will be clear... as glass.

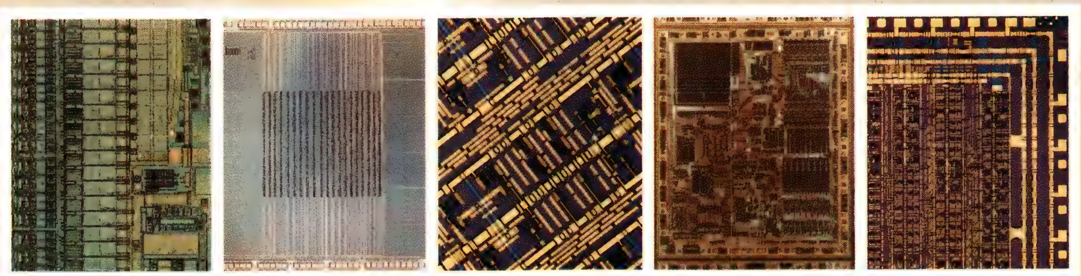
CHERRY®

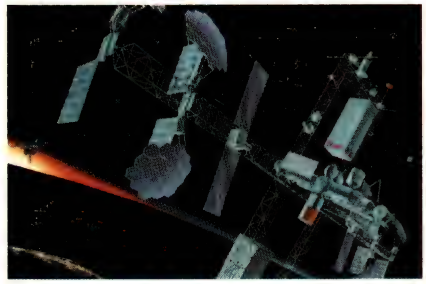
CHERRY ELECTRICAL PRODUCTS
3600 Sunset Avenue, Waukegan, IL 60087 • (312) 360-3500
Switches • Automotive Devices • Electronic Components • Displays • Printed Circuit Boards • ICs • Keyboards



Circle 111 on reader service card

See us at WESCON/San Francisco, Nov. 17-19, 1987, Cherry Booth #517





One workstation, one company, for all your military/space designs.

Remember when semicustom IC designing was impractical because your technology options were too limited, your CAD tools too new and turnaround too slow?

Times have changed! Now Harris makes designing military/space ASICs — in the broadest range of technologies — easier than ever. Because you use the same workstation and design tools for all.

Libraries of solutions: Our GaAs DIGI-II library offers nearly 50 fully characterized cells that are ECL, TTL, CMOS or GaAs compatible. Or...in silicon our advanced HSC 2.0-micron rad-hard CMOS library provides cells and macros you can intermix. Resident libraries also exist for CMOS and bipolar, analog, and digital plus analog/digital mixed technologies.

Hardware and software: Our open-system software CAE/CAD toolset fully integrates with Harris/Masscomp workstations, and meshes easily with other UNIX-based platforms. Daisy and Mentor support is also available.

On to manufacturing: You handle the front-end; leave the back-end to Harris. We carry your ASIC design through to mask, then manufacturing — with the screenings you want and most popular packages: metal flat-pack, side-brazed DIP, chip carriers, and more.

Guaranteed survivors: Now you can create ASICs that tap the high speed of GaAs, or the low power of CMOS, and are guaranteed to survive military and space environments. And you can do it faster.

For more on military/space silicon and GaAs ASICs, send for our Rad-Hard/Hi-Rel Data Book. Contact Harris Systems Ltd., Semiconductor Sector, Eskdale Road, Winnersh, Wokingham, Berks, RG11 5TR, England. Phone 0734-698787.

IN MILITARY ASICs, THE NAME IS

HARRIS

Harris Semiconductor: Analog - CMOS Digital
Gallium Arsenide - Semicustom - Custom

HARRIS

©1987, Harris Corporation

Circle 180 on reader service card

THE 1 MEGA DRAM IN 4 MEGA TECHNOLOGY.

MEGABITS, TAILOR MADE.

Plan today to the standards of our 4 Mbit DRAM of tomorrow.

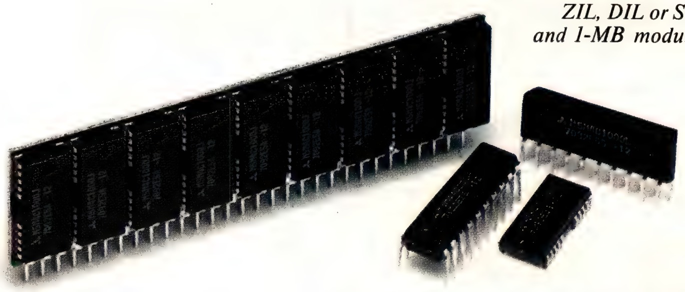
Three address modes: fast page, static column, nibble. For more flexibility with less effort in circuit design.

Fast memory access: 80 ns. For high-performance systems that give you the competitive edge in the technological race for success.

Three different packages to choose from. And if it's customized layouts you're after, we're also your professional expert.

For tailor made solutions geared to your future needs, just give us a call.

Available in production quantities:
ZIL, DIL or SOJ
and 1-MB module.



MITSUBISHI
SEMICONDUCTORS

MITSUBISHI ELECTRIC EUROPE GMBH
Gothaer Str. 8 · 4030 Ratingen · Tel. (02102) 486-307
Munich Office: Tel. (089) 919006 West-Germany

Circle 172 on reader service card

Plug-In To Our Network And Receive A Free Issue Of...

Five dollars
Data Communications
McGraw-Hill's Magazine of Information Networks and Communications Technology
Networking futures:
The human connections

If you're responsible for the use, planning, design and implementation of information networks...YOU should be connected to this magazine.

DATA COMMUNICATIONS is devoted 100% to reporting and exploring developments in digital communications. And it publishes more than half of all networking information printed in the USA!

In it you will find practical ideas to help you enhance productivity in your own environment, build more efficient systems, cut costs and avoid mistakes.

Each issue examines methodologies of computer applications...system design and optimization...message switching...integrated voice, data and video...diagnostics, error detection and testing...digitized voice ...common carrier facilities...software and network design...and more.

But don't just take our word for it. Let us send you a free issue to read and evaluate. Simply complete and mail the postage-paid card adjacent to this page. We'll send you a copy of the current issue, along with our invoice for the term you select. If you like what you read, send us your payment. If not, just write "cancel" on the bill, return it, owe nothing and keep the free issue with our compliments.

So plug-in to our network now...and see for yourself why DATA COMMUNICATIONS is recognized as the world's leading networking magazine.

McGraw-Hill

Data Communications

MILITARY/AEROSPACE NEWSLETTER

TASK FORCE SLAMS DOD FOR BUNGLING MILITARY SOFTWARE EFFORTS

The Defense Department's efforts in software development are disjointed, uncoordinated, and lack support, charges the Defense Science Board's Task Force on Military Software. The task force reports it "is convinced that today's major problems with military software are not technical problems, but management problems." It lambastes the DOD for having "not provided the vital leadership needed" in Stars, the Software Technology for Adaptable Reliable Systems. It complains that Ada, the high-level programming language the DOD is pushing to make a standard for all military systems, "has been overpromised." It warns that "the Strategic Defense Initiative has a monumental software problem" and that "no program to address the software problem is evident." To solve the management problem, the task force urges the DOD to bring together Stars, Ada, and the Software Engineering Institute under the Air Force Electronic Systems Division. It also wants representatives from the three programs and from the Defense Advanced Research Projects Agency's Strategic Computing Initiative to produce a "one-time joint plan to demonstrate a coordinated DOD Software Technology Program." What does the DOD have to say? Not much just yet. Officials at the Ada Program office did not respond to calls, and a Darpa spokesman would say only that the agency "has no plans to implement any of the changes that the report recommends" at this point but will take them under consideration. □

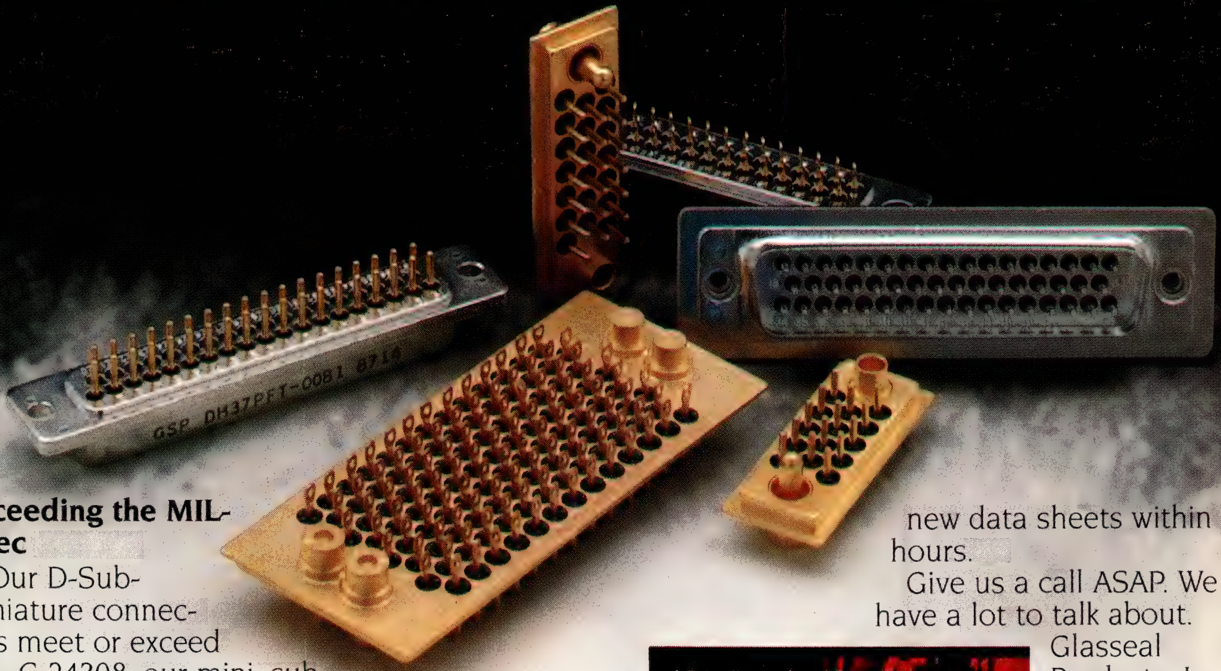
EVEN VHSIC FAILURES HAVE TURNED OUT WELL, MAYNARD SAYS

The Defense Department's Very High-Speed Integrated Circuits program is a success overall, says E. D. "Sonny" Maynard, VHSIC program director and director of computer and electronic technologies at the DOD. Maynard says a number of VHSIC nightmares have turned, overnight, into success stories. Texas Instruments Inc., for example, "had delays with its bipolar process and fell years behind," he says. "Now TI is a big winner, getting its 1750A VHSIC chip into the Advanced Tactical Fighter program." Honeywell Inc. "had some difficulty getting its CMOS process on line, but no loss," he adds, pointing to Honeywell's success as a chip supplier to supercomputer maker ETA Systems Inc., of Minneapolis. Finally, Maynard says, "perhaps the most used VHSIC chips of all" are gate arrays and memory parts from Westinghouse Corp.—even though Westinghouse's other parts never made it into a single system. "My assessment is that the total effort has more than achieved the goals that it started with," Maynard says, disputing criticism that the program has taken too long to accomplish too little. "We needed to get over the idea that we could just use commercial microprocessors." But as Phase 2 prototype chips begin to arrive, Maynard has another worry: "one of the trickiest parts of any program is bringing it to conclusion." □

U. S. AND FIVE NATO ALLIES WILL DEVELOP NEW ANTIAIRCRAFT WEAPONS

The U. S. and five allies will explore ways to improve shipborne antiaircraft weapons under an agreement to develop future air defenses for ships belonging to North Atlantic Treaty Organization members. Canada, the Netherlands, Spain, the UK, and West Germany joined the U. S. late last month in agreeing to enter the exploratory phase of the NATO Anti-Air Warfare Weapon System Program. The program is aimed at defending NATO ships against airborne threats, particularly short-range ones such as that posed by anti-ship missiles. Antiaircraft weapons developed under the NATO program will have "direct application to the NATO frigate replacement" program, says a U. S. Navy spokesman, and will be used to retrofit existing ships as well. The program will be managed by an international program office that will be based in Washington. □

WHY YOU SHOULD CALL GLASSEAL ABOUT HERMETIC D-SUBS AND MINI RECTANGULAR CONNECTORS ASAP.

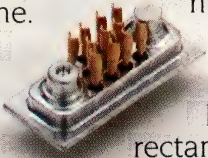


Exceeding the MIL-Spec

Our D-Subminiature connectors meet or exceed MIL-C-24308; our mini, sub and micro-miniature rectangulars MIL-C-28748. The result is the highest level of reliability that you can find.

High-volume production

Many manufacturers of hermetic connectors can't deliver large volumes of product in a short period of time. The technology is simply too complex. But we do—without compromising quality.



Our in-house capabilities, from engineering and design to custom manufacturing expertise, assure you consistently high yield rates.

Fast service, too

If hermetic D-Subs or rectangulars are part of your design criteria—be it military or commercial—give us a call. We'll mail you a copy of our new data sheets within 48 hours.

Give us a call ASAP. We have a lot to talk about.

Glasseal
Products, Inc.,
An HCC
Industries
Company,
P.O. Box 978,
485 Oberlin Ave.,
Lakewood,
NJ 08701
201-370-9100
FAX: 201-370-7107
TWX: 510-600-4467

GLASSEAL™

GSP™

©1987 Glasseal Products, Inc.

AN HCC INDUSTRIES COMPANY hcc

Circle 123 on reader service card

AN EXECUTIVE PLANNER TO USE WITH PRIDE.

Electronics magazine is pleased to offer its readers a distinguished, elegant Desk Planner and Pocket Diary Set for 1988 that is packed full of useful information and traveling tips, in addition to providing you with an easy-to-use 1988 planning format.

A great gift idea.
This beautiful book makes an ideal gift for friends and business associates. It's a gift that people will really appreciate receiving. Because it's a gift from you that they'll use all year long.

Make it personal.
And you can order your name, or the name of anyone you are giving the book to, embossed in gold on the padded front cover.

Act now and place your order today.
Order your copy today. And copies to give friends and business associates for the holidays. It's also a great gift idea for anyone who travels—or dreams of traveling. Write to us at Electronics Desk Planner, P.O. Box 5505, Peoria, Illinois 61601.
Or call 1-800-845-3636.

HERE ARE JUST SOME OF THE GREAT FEATURES.

QUALITY WORKMANSHIP
- Large 8½" x 10½" page size
- Handsome textured cover with padded front
- 2 silken ribbon markers for easy reference
- Highest quality paper for smooth writing capability
- Gilt-edged pages
- Inexpensive personalized embossing

WITH CONVENIENT FEATURES
- Week-at-a-glance appointment guide with 12-month calendar on each spread and plenty of room for reminders
- Special 4-page 1988 planner and 4-page 1989 forward planner for highlighting special events
- Easy-to-read 6-year calendar
- Ample room for notes

AND HANDY INFORMATION
- Convenient metric conversion table and weights and measures table for quick reference
- International dialing codes

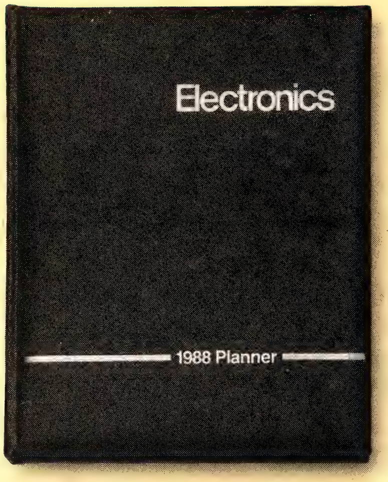
GREAT FACTS AND TRAVELING TIPS
- 22 beautiful full-color world maps, including time zones, air routes and sea routes
- International airports and distances from key cities
- Detailed guides for 117 countries and cities, weather, hotels, selected restaurants, banks, credit cards, tipping information, sight-seeing, and much more
- International entry and exit requirements
- Air distances and flying times between countries
- Detailed maps of major foreign cities

ORDERING INFORMATION
Prices include cost of surface delivery.
Add local sales tax.

Desk Planner & Pocket Diary Set	$39.95
Desk Planner only	$31.95
Pocket Diary only	$16.95
Gold Stamping full name on each item	$ 4.50
Handling/Packing per item	$ 1.50
Gift Box (optional)	$ 1.00

OPTIONAL AIRMAIL SURCHARGES

Shipped from New York to:	Set or Planner	Diary Only
Canada	$ 5.00	$ 3.50
Central America	8.50	1.50
South America	14.00	2.00
France, England, Spain	14.00	3.50
Singapore, Japan, S. Africa, Australia	19.50	5.00



DESK PLANNER AND POCKET DIARY SET

ONLY $39.95

All major credit cards are accepted.
To order send check or money order to Electronics Desk Planner, P.O. Box 5505, Peoria, Illinois 61601. Or call toll-free

1-800-845-3636

McGraw-Hill Electronics

PROBING THE NEWS

HAS SILICON VALLEY LOST ITS ZING?

NO, BUT IT'S CHANGING: CHIP COMPANIES NO LONGER LEAD ITS GROWTH

by Jeremy Young

It's showtime in San Francisco, and no one knows it better than the denizens of the sprawling technology center a few miles to the southeast. It's Silicon Valley that has given the San Francisco editions of Wescon their heft, a good bit of their sparkle, and most of their showgoers. But this year's show, from Nov. 17 to 19, may be a bit subdued—the Valley has been taking some lumps lately.

Are the days of glory past for Silicon Valley, where the integrated-circuit business so central to the high technology industries first blossomed, and then boomed? After the long semiconductor market slump of 1985 and 1986, after the chilling blast from the financial markets last month, will the Valley ever gestate strong new technology startups again? Or is its vitality gone?

Media reports of late would have it so, but rumors of the Valley's death are premature. Tremendous innovative and entrepreneurial energy still drives the region. No one would deny the fact that there are problems in the Valley, probably foremost among them the struggles of the U. S. semiconductor industry. And in recent years past, so many companies were being started so rapidly that inevitably, perhaps, a number got launched that were too weak, in terms of concept, management, or market potential, so some weeding out was required, adding to the bad news that has dogged Silicon Valley of late.

But bad press has not stopped the Valley's growth. Strong expansion continues, although not at the breakneck pace of the last decade, and not in the same sectors of the industry. The chip sector may never reach the prominence it once held, but other types of business are doing very well (see figure). Computer businesses, for example, systems, peripherals, and software look good. So does instrument manufacturing in the areas of medicine and biotechnology.

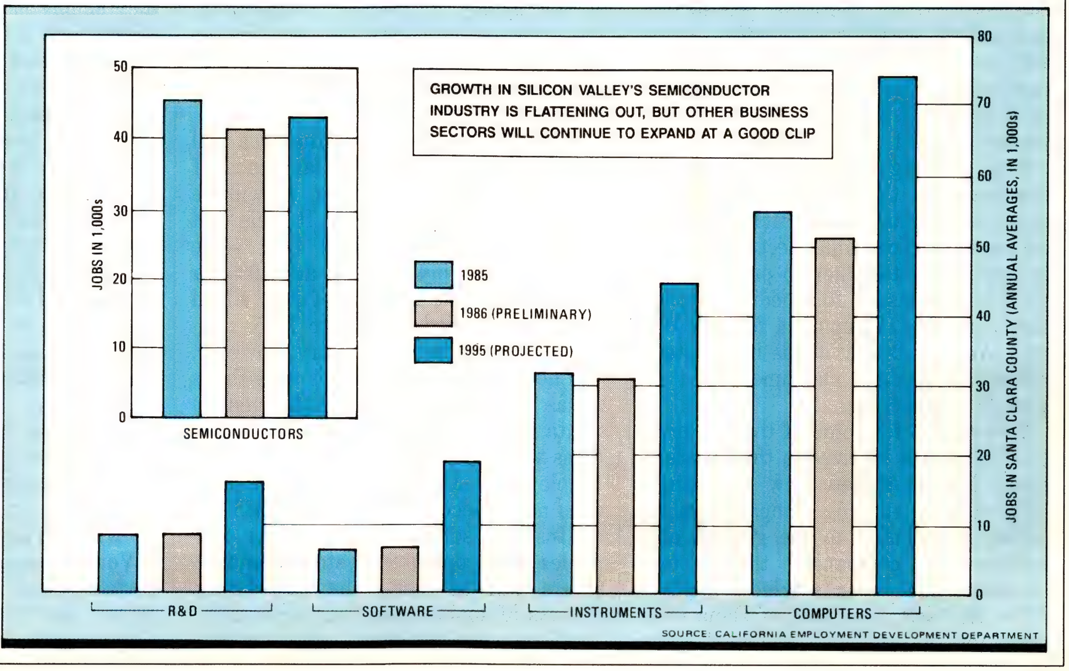
Industry observers expect much of the growth to come from young companies, startups, and small companies growing to successful midsize organizations. Such companies thrive in Silicon Valley, most say, because of the kind of people who live there: intelligent, skilled, highly motivated people, many of whom came there to be among their peers and to enjoy the physical surroundings of northern California.

And though October's stock-market debacle has left the question of available capital very much up in the air for startups, many cite the presence of active and experienced venture capitalists in the valley as one of its prime assets. Smart venture-capital people also link their fledgling companies with other parts of the Valley's wide network of support services. This infrastructure makes Silicon Valley a fertile garden bed for small high-tech companies that may well have no equal, anywhere.

Even real estate has its advantages in Silicon Valley. The cost of housing is high, but in the last two or three years, office and plant space has been plentiful, to the point where new companies could find a place to set up without laying out much cash, if any at all.

HIGH-TECH SEEDS. Nearby universities and research institutions also contribute to the Valley's technological health and diversity. Graduates from the engineering schools seed the Valley with young talent, and technology developed in academic and government-backed research labs often provides the foundation for new companies building new kinds of high-tech products.

All of these factors add up to a technological critical mass, a hot reactor of ideas and businesses that, when examined, shows no sign of growing cold. The Valley is changing, and its growth is likely to be more paced in the coming years, but it is not dying. Founders of several recently started companies, when asked, unanimously recommend



GROWTH IN SILICON VALLEY'S SEMICONDUCTOR INDUSTRY IS FLATTENING OUT, BUT OTHER BUSINESS SECTORS WILL CONTINUE TO EXPAND AT A GOOD CLIP

SOURCE: CALIFORNIA EMPLOYMENT DEVELOPMENT DEPARTMENT

Valley. About 60% of the $1.2 billion venture capital pool in the U.S. last year was sunk into firms in California, says Richard Shaffer, president of Technologic Partners of New York and publisher of the Technologic Computer Letter. Of that 60%, he says, the overwhelming majority was invested in the San Francisco Bay area. And there's no slowdown: five of the 10 largest U.S. computer and electronics venture capital investments made in the first quarter of 1987 were in Silicon Valley, he says.

Management talent is crucial to the development of new high-tech businesses, Shaffer adds. The venture capital community is largely an "old boy's network," he points out. "If you are a former Intel executive who has gone into venture capital, where are you going to go looking for management talent?" The answer, of course, is among former business associates. "The venture capitalists need to know the reputation and history of the people they invest in, so they tend to choose people they know."

But the money stream doesn't flow as freely as it once did. "The venture community has seen all the bad news it ever wants to see," says Hughes of Precision Image. "They used to be more passive. Now they're far more involved" in the businesses they invest in. Even before the market crash, agrees Dana Computer's Michaels, it had become much more difficult to capitalize a new company because of the increasing levels of caution among venture capitalists.

But there's still room for a good idea backed by a good, solid management team, says Hughes. The venture capitalists have not fled; instead they have become far more active in supporting the companies they back. They help a startup company get the right kind of people on the board of directors, he says—not just financial experts, but people who can get involved in operations. He turned to his venture backers for advice, to find recruiters and competent lawyers.

It's this kind of background support that makes Silicon Valley a crucible for new companies. "There is an entire network of services available for starting a business," says Harry Reinstein, president and chief executive officer of Aion Corp., Palo Alto. He founded Aion in 1984 to develop expert systems to increase the productivity of programmers of mainframe computers. The quality of that network of services was crucial to Aion's development, Reinstein says, as was the experience provided by the Valley venture community.

Other services available in the Valley include companies that build electronic subassemblies, companies that do mechanical and electrical design, companies that build chips, even machine shops, says Hughes of Precision Image. This is important for a small company with limited resources, he says. His plotter-manufacturing company buys parts and puts together a kit. Then it sends the kit out to be stuffed into boards and soldered, and gets back finished subassemblies. "We can get the whole thing done here," he says. "If you have a problem, you jump in the car and go talk to the supplier"—instead of having to take a trip halfway across the country.

MOORE: The critical mass of talent led Intel to build a new semiconductor plant in the Valley.

There's still room for a good idea backed by a solid management team

Startups have also benefited greatly by the surplus of commercial real estate that has existed since 1984. The result of massive speculative real-estate development during 1982 through 1984, the market glut is often cited as a signal of the decline of the region. But from the point of view of a startup with tight capital, the situation has been very attractive. "The real-estate thing is wonderful for me," says Thomas Roberts, president of Thomas A. Roberts Inc., San Jose. He started the company in 1985 to do custom automation work—in Apple Computer's Fremont production plant, for example—and other mechanical engineering contracts in robotics and medical instrumentation.

Startups have been able to move into commercial space without up-front expenses such as deposits, says Reinstein of Aion. Valley real-estate people assess the credit-worthiness of a new company differently than is done elsewhere, he points out. There's no point refusing a company credit because it has no credit history—at least not in the Valley, where new starts are so common.

The attractive real-estate conditions, however, may not last much longer. Vacancy rates are declining in the Valley, say local realtors. Between July 1986 and July 1987, the Valley's vacancy rate for office space came down from 25% to 23.5%, and industrial-property vacancies dropped from 18% to 16%, according to statistics prepared by Coldwell Banker's San Jose office. Business in the region has been turning up, and real-estate developers are for the first time in several years competing to buy vacant land, getting set for what they see as a budding market upturn.

Another big Silicon Valley selling point is the benefit high-tech companies derive from the presence of high-quality university programs and research institutions in the area. The interaction between the universities and industry has "an underlying cultural impact," says Dave West, president of Visual Software Inc., a three-year-old Santa Clara company that produces tools for computer-aided software engineering. Young people with a technical bent come to the area for an education and often stay when finished with school—either as researchers at the schools or taking jobs in industry.

"Stanford and Berkeley are much, much more active in technology today than they were 10 to 15 years ago," says Regis McKenna. Thomas Roberts' company is one of many that benefit, having just completed a project that originated in Stanford University.

It all adds up to a potent technology engine with its own momentum. Silicon Valley has become self-perpetuating, says McLaughlin of the state's Employment Development Department. "It almost can't *not* grow." And it will, if prospective startups listen to the advice of company founders interviewed by *Electronics.* To a man, they recommend the Valley as a place to start an electronics company, and see no reason why a startup with a solid concept and good management shouldn't be able to find the support it needs there. Would-be entrepreneurs must, however, "have a good story to tell," as one puts it.

Even the semiconductor sector, though it is a declining factor in the Valley, still feeds off the Valley's momentum. Intel's plans to build a $95 million process-development facility focused on nonvolatile memory and microcontroller chips in Santa Clara demonstrates the company's commitment to its birthplace.

The most important factor in locating the new facility in Silicon Valley was people, says Gordon Moore, chairman of Intel. It might be cheaper to build it out of state, but Moore says it would be very difficult to persuade Intel's established research and development staff to move. "It is much easier to build it here, where we have the people," he says. ☐

NEW PRODUCTS

$1,000 PC-BOARD ROUTER HANDLES 400 ICs, 30 LAYERS

OMATION'S SCEHMA-PCB RUNS ON DESKTOP MACHINES

COMPLETE. Omation's router software for pc boards works with its layout package; it also adds error checking.

Desktop personal computers can tackle most jobs performed by printed-circuit-board routing systems costing up to $50,000 by using a new software package from Omation Inc. that costs less than $1,000.

Omation's software developers streamlined popular board-routing algorithms to achieve the Schema-PCB package's cost effectiveness. To make system cost even more attractive, the Richardson, Texas, company designed Schema-PCB to run efficiently on IBM Corp. PCs and PC-compatible systems.

The software's netlist data-base management system gives desktop computers the power to complete large board designs with over 400 equivalent integrated circuits and up to 30 signal layers.

Although routing time varies widely with board complexity, the package's Schema-Route module option has completed 90% to 95% of interconnections on a typical personal-computer add-on card in less than 45 min. Omation has used the personal-computer autorouter on larger boards—some measuring up to 13 by 10 in. with six signal layers—and achieved 78% of the connections on the first pass. But its target market is mostly for smaller boards.

Schema-PCB runs off design inputs from Schema-II, the firm's latest schematic-capture engineering package, which was introduced earlier this year. Together, Schema-PCB and Schema-II enable color graphics-equipped personal computers to handle all the steps of board layout, autorouting, error-checking, and full documentation for pc-board manufacturing.

The combination "allows engineers to go from the front-end to back-end steps of pc-board design and layout," says John R. Hoskins, vice president of sales and marketing. "The integrated package can go from schematic entry to pc-board layout, and then make back-annotated changes as the work continues, keeping the design consistent throughout the package."

"For most engineers, we aim to have this system pay for itself on their first board design," adds Hoskins, referring to typical charges of pc-board layout services costing from $2,000 to $10,000.

The autorouter uses four separate algorithms to perform its work. Three of them are heuristic algorithms for power-ground, memory, and horizontal-vertical routing. A fourth is a maze-search algorithm which makes eight passes at improving connections. It targets eliminating all unnecessary vias for easier manufacturing of the board design.

Wescon/87®

Wescon traditionally boasts a wider variety of product offerings than special-application conferences, and this year's show in San Francisco from Nov. 17 to 19 is no exception. The more than 50,000 expected visitors browsing the offerings of 900 exhibitors will find everything from computer-aided-design products to semiconductors to power supplies, some of the best of which are highlighted here.

Schema-PCB can handle boards measuring 32 by 32 in. with over 400 equivalent ICs. The system features a component library representing over 2,000 devices (TTL, CMOS, and a collection of popular microprocessors). A fully-loaded Schema-PCB and schematic-capture package will perform error-checking on electrical and manufacturing parameters. Unconnected inputs, for example, are cross-checked with connectivity design rules, and incorrect spacings of lines or vias are flagged by programs that check for open circuits and other errors.

The Schema-PCB package also features resolution of component placement and tracking of 1 mil. Selection of variable track width or pad size and shape can be made in 250 increments covering 1 mil. Post-processing routines generate all of the information needed to make the boards, with outputs generating artwork on popular plotters and manufacturing equipment.

"Many of these features are not generally available on lower-cost PC-based packages," says Hoskins. "Our charter is: if there is a useful feature on more expensive packages, we will put it in our low-cost package, if the job is within the host's capability." Personal-computer processing power has grown to the point, he adds, where speed is the only major difference between Schema-PCB and board-layout systems costing $50,000 or more.

The basic Schema-PCB software package costs $975 and becomes available in November. The Schema-II schematic-capture package has a base price of $495. Schema-Route, which is a personal computer-optimized Lee algorithm option, sells for $875.

Omation is also expected to make available an additional high-performance rip-and-retry autorouting program later this year. It is expected to cost about $4,500. – *J. Robert Lineback*

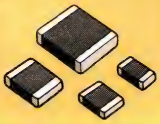
Omation Inc., 1210 E. Campbell Road,
No.100, Richardson, Texas 75081.
Phone (214) 231-5167 [Circle 400]

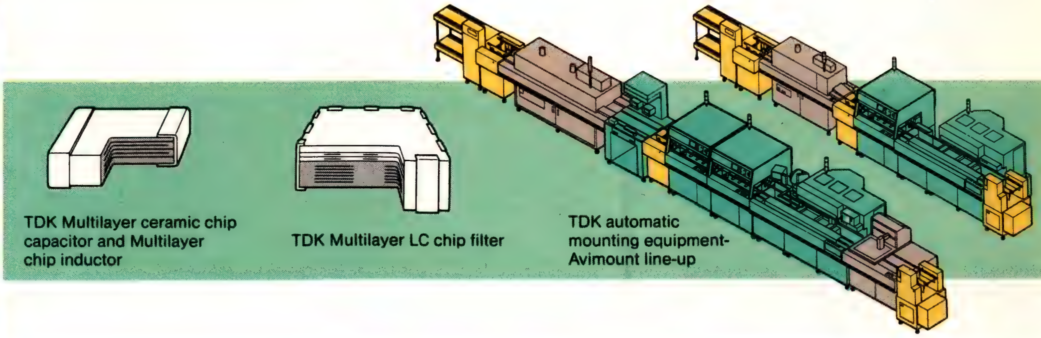
In Surface Mountable Components, TDK Quality Is More Than Skin Deep.

As boards are getting thinner, TDK is helping that diet succeed by providing a variety of extra-slim surface mountable components. Nourished by TDK's expertise in ferrite and ceramic materials, these miniaturized components feed on TDK—developed multi-layerization and multi-functionalism. How do we know the exact needs of high-quality automated board production? Well, a fair share of the world's automatic mounting equipment—the Avimount series—comes from TDK.

Multilayer Ceramic Chip Capacitor

C1608 (CC0603)
C: 0.5～22,000pF
C2012 (CC0805)
C: 0.5～100,000pF
C3216 (CC1206)
C: 0.5～220,000pF
C3225 (CC1210)
C: 750～470,000pF
C4532 (CC1812)
C: 2,400pF～1μF
C5650 (CC2220)
C: 5,100pF～1.5μF




TDK Multilayer ceramic chip capacitor and Multilayer chip inductor

TDK Multilayer LC chip filter

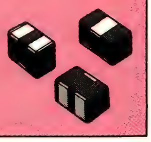
TDK automatic mounting equipment-Avimount line-up

Multilayer Ceramic Chip Capacitor (High Frequency, Low Loss)

FC1414
C: 0.5～3,300pF
FC2828
C: 0.5～22,000pF
FR1414
C: 0.5～3,300pF
FR2828
C: 0.5～22,000pF

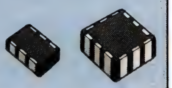
Multilayer Chip Transformer

MTT4532
L: 10～200μH



Multilayer Chip LC Filter

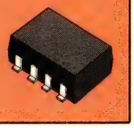
MXF4532H
HPF (Tuner)
MXF4532B
BPF (FM radio)
MXB5050B
BPF (VCR)
MXB5050L
LPF (VCR)
MXB5050D
Delay Line (VCR)



A variety of characteristics are available.
Please specify when ordering.

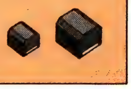
SM Active Delay Line

FDL
Delay time: 20～75 nsec.



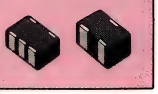
Leadless Inductor (Wound Chip Inductor)

NL322522
L: 0.01～220μH
NL453232
L: 1.0～1,000μH
NL565050
L: 1,200～10,000μH
NLF453232
L: 1.0～1,000μH
(Shielded Inductor)



Multilayer Chip IFT

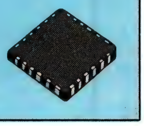
MIA4532
F: 455, 459, 464kHz
MIF4532
F: 10.7MHz



Multilayer Chip Capacitor Network

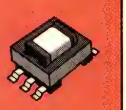
MCN7575
TC: CH, 1～100pF (10 capacitors)
SL, 10～1,000pF (10 capacitors)

Class Ⅱ, 100～470,000pF (10 capacitors)



SM Transformer/ Inductor

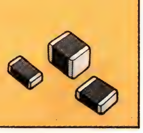
EE5
ER9.5
ER11
T2



A variety of characteristics are available.
Please specify when ordering.

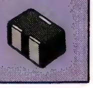
Multilayer Chip Inductor

MLF3216
L: 0.047～33μH
MLF3225
L: 39～220μH



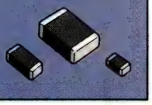
Multilayer Chip LC Trap

MXT4532
F: fo ±2%



Ferrite Chip Beads

CB201209
Zo: 7, 10, 11Ω
CB321611
Zo: 19, 26, 31Ω
CB322513
Zo: 31, 52, 60Ω
CB453215
Zo: 70, 120, 125Ω



SM Step-up Inductor (Piezoelectric Buzzer)

OL3.3 x 1.6
OL3.3 x 2.1

Inductance values are representative, please specify value when ordering.

See our Surface Mountable Components and other fine products at Wescon/'87 November 17-19, booth No. 959, Moscone Convention Center, San Francisco, CA.

Wescon/87

TDK®

TDK CORPORATION OF AMERICA HEAD OFFICE 4711 West Golf Road, Skokie, IL 60076, U.S.A. Phone: (312) 679-8200 CHICAGO REGIONAL OFFICE Phone: (312) 679-8200 INDIANAPOLIS REGIONAL OFFICE Phone: (317) 872-0370 NEW YORK REGIONAL OFFICE Phone: (516) 625-0100 LOS ANGELES REGIONAL OFFICE Phone: (213) 539-6631 DETROIT DISTRICT OFFICE Phone: (313) 353-9393 NEW JERSEY DISTRICT OFFICE Phone: (201) 736-0023 HUNTSVILLE DISTRICT OFFICE Phone: (205) 539-4551 GREENSBORO DISTRICT OFFICE Phone: (919) 292-0012 DALLAS DISTRICT OFFICE Phone: (214) 506-9800 SAN FRANCISCO DISTRICT OFFICE Phone: (408) 437-9585 **TDK CORPORATION.** TOKYO, JAPAN.

Circle 133 on reader service card

THE BUCK

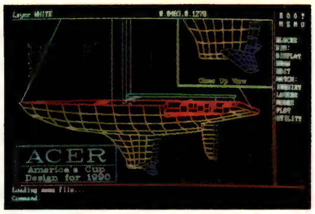
The ACER 1100. A 386 System for mini-computer megapower – without the megabucks

Driven by the power of a 16MHz 80386 microprocessor, the ACER 1100 is by far, the fastest 80386 system around – at 10% faster than the fastest machine, to date. At the price of a standard AT.

Transpose this to your particular business requirement. See how tasks – like inventory, payroll – are over faster than you can say IBM.

Here today, here tomorrow

And that's just the beginning. The ACER 1100 expands the limits of today's computing – runs US$6 billion worth of existing software, up to 300% faster than standard AT's. Plus, the ACER 1100 is an investment in the future – this is one machine that will run tomorrow's advanced 32-bit software, up to 1000% faster than the AT's of today.



The 1100 makes a powerful yet economical CAD/CAM workstation.

With 32-bit architecture, unique interleaved memory and a massive expansion ability, the ACER 1100 speeds you into the realms of tomorrow.

A number-tumbling whiz

But that's not where it ends. Power hungry users will find the 1100's generous storage and lightning processing speed indispensable for spreadsheet and financial applications, CAD, CAM, CAE, software development – even artificial intelligence applications.

Not to mention network server needs.

For calculation-intensive applications, success is certainly in the books.

Success breeds success

Our commitment to research and development has enabled us to build better, more affordable machines. Like our ACER 1100 – already it is setting the 32-bit standard for others to follow.

One more thing. No matter where you are, we guarantee after-sales service through our worldwide distribution network.

Acer. A name synonymous with quality, reliability, price performance and advanced technology. In short, value.

From home computers to super-micros – meet the Acer team of PC's.

Invest in the ACER 1100. At the price of a 286, it's a small ante that'll pay off in big bucks.

STARTS HERE

Technical Specifications

ACER 1100B CPU 80386, 4.77/6/8/10/12/16 MHz switchable. Socket for 80387 math coprocessor. 8 slots for 32-bit, 16-bit AT compatible, 8-bit PC compatible. RAM 1MB, system maximum 16MB. 1FDD, 1.2MB. Microsoft® MS-DOS® 3.2., GW-BASIC® 3.2.
ACER 1100E As 1100B plus 1WDD, 40MB, 28ms.

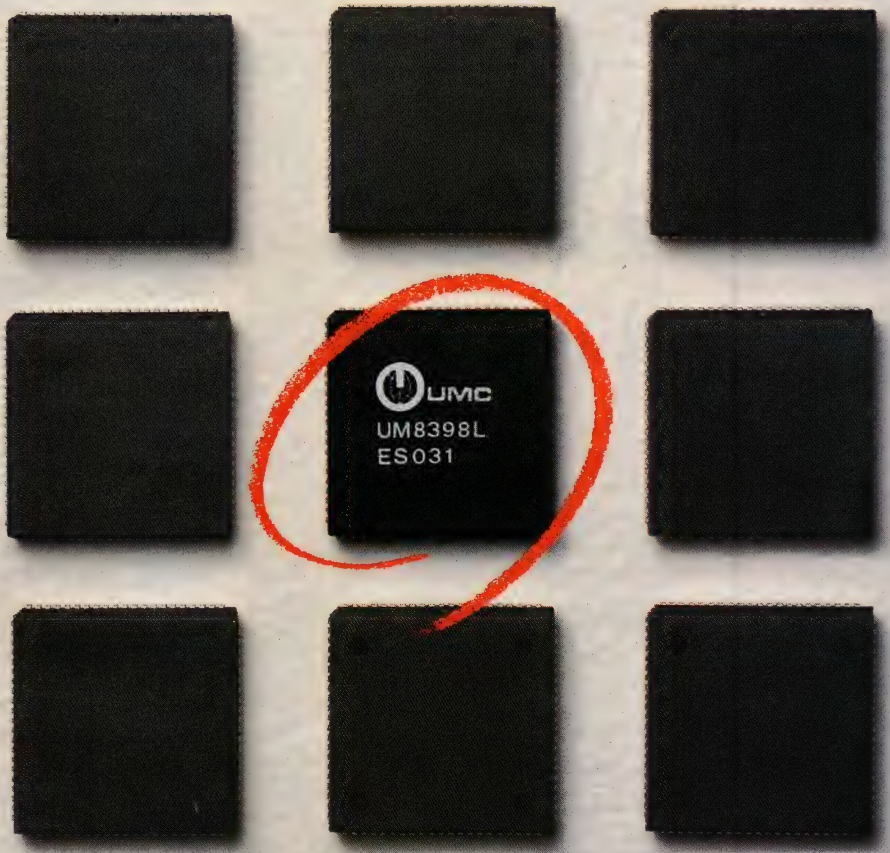
Microsoft MS-DOS is a registered trademark of Microsoft Corporation.
PC-AT is a registered trademark of International Business Machines Corporation.

Acer Technologies Corporation
401 Charcot Avenue, San Jose, CA 95131.
Tel: (408) 922-0333. Fax: (408) 922-0176.
Toll-free nos: (800) 782-1155 (CA only), (800) 538-1542.

ACER
A New Word For Value

Circle 135 on reader service card

Win with UMC, Your Only Choice.



Faster + More Reliable + More Cost-effective

UMC is one of the leading advanced IC manufacturers for IBM PC compatible systems. We supply chips and integrated chip sets to meet the requirements in IBM PC and PC compatible systems. Our chips plus your design make your systems faster, more reliable, and more cost-effective.

Planning to conquer the PC system market? Win with UMC is your only choice.

We supply chips for PC/AT, PC/XT main board, display card, FDC card, HDC card, EGA card, and multi I/O card.

IBM, AT, XT, and EGA are registered trademarks of International Business Machines Corp.

UMC **UNITED MICROELECTRONICS CORPORATION**

For more information please contact:

U.S.A. HEADQUARTERS: NMC CORPORATION
3350 SCOTT, BLVD, BUILDING #57 SANTA CLARA, CA. 95054
TEL: 408-727-9239 TLX: 172730 NMC SNTA FAX: 408-9700548

Circle 137 on reader service card

Avis features GM cars.
Cadillac Sedan deVille.

AVIS SUPERVALUE
$45 A DAY
for a Cadillac Sedan deVille.

A comfortable Cadillac Sedan de Ville or similar group car for only $45 a day. Available at many Avis locations across America.

And this cozy price comes with everything you expect from the We try harder® people. Like Avis Express® service, Avis Rapid Return℠ And now at selected airports across the U.S., Avis Roving Rapid Return, the new Avis Carside Computer℠ return service that takes just seconds to complete. So travel in style with an Avis Cadillac. For information and reservations, call 1-800-331-1212. Or see your travel consultant.

AVIS®

Red hot℠

Cars are available at selected U.S. locations, subject to availability, and must be returned to renting location. These rates are nondiscountable, and rates, terms and conditions are subject to change without notice. Rates have a free-mileage allowance. There is an additional per-mile charge in excess of this allowance. Refueling service charge, taxes, optional CDW, PAI, PEP, and ALI are not included. Cadillac or similar group car available in New York area at a higher rate. Rates higher for renters under 25. At certain locations a charge for additional drivers will apply. Seasonal surcharges and blackout periods will apply. Call Avis for complete details. © 1987 Wizard Co., Inc.

Circle 139 on reader service card

Introducing a new desktop plotter that's small enough to fit in this magazine.

Electronics
HERE COME THE TOOLS TO DESIGN 50,000-GATE ASICS
TOOLS
COMPUTER GRAPHICS DEMONSTRATION
POWER READY ALARM
FUJITSU

Fujitsu's new FPG-310 plotter is truly compact: it needs only 420 × 260 mm, which leaves you plenty of elbow room. The FPG-310 weighs less than 5 kg and draws less than 35 watts of power.

A wide variety of media

Now you can print figures and text on almost any medium – coated paper, OHP films, tracing paper and, of course, standard paper. And the medium can be any size from postcards to A3 sheets.

Superb graphics

Precise 0.025 mm resolution and 6 bright colors raise your computer's graphics to new heights of effectiveness. The FPG-310 gives you the flexibility of a dot matrix printer but provides far superior quality.

Full compatibility

Three standard interfaces – Centronics, RS-232C and GP-IB – let you connect the plotter to virtually any personal or business computer.

Amazing versatility

Applications include business graphs, education, measurement systems, FA – and even personal CAD. Hobbyists also find the plotter useful for a wide variety of tasks.

Whether you use the FPG-310 in your home office or in a workstation, no job is too big for this little plotter.

Fujitsu Color Plotter FPG-310

FUJITSU MIKROELEKTRONIK GmbH:
Arabella Center 9. OG./A, Lyoner Straße 44-48, D-6000 Frankfurt am Main 71, F.R. Germany Phone: 069-66320 Telex: 0411963 Fax: 069-6632122
FUJITSU COMPONENT OF AMERICA, INC.:
3320 Scott Blvd., Santa Clara, California 95054-3197, U.S.A. Phone: 408-562-1000 Telex: 910-338-0190 Fax: 408-727-0355
FUJITSU LIMITED (Electronic Components International Marketing Div.):
Furukawa Sogo Bldg., 6-1, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100, Japan Phone: National (03) 216-3211 International (Int'l Prefix) 81-3-216-3211
Telex: 2224361 Fax: (03) 216-9771

FUJITSU

Circle 175 on reader service card

Once again,
Compaq
raises the standard
of performance
for personal computers.

This time
by a factor of two…

most powerful PC's
and off.

and the new 20-MHz COMPAQ PORTABLE 386™

to run at its maximum speed. Together, they insure the highest system performance without sacrificing compatibility with industry-standard peripherals.

Both computers offer disk caching. Both offer the most memory and storage within their classes. Both let you run software being written to take advantage of 386 technology. And both run new MS-DOS®/BASIC Version 3.3 as published by Compaq. With it, our new portable and our new desktop can break the 32-megabyte limit on file sizes that handcuffs other PC's, allowing you to build files up to the size of your entire fixed disk drive.

And from now until December 31, 1987, both computers come with a free package of new Microsoft® Windows/386 Presentation Manager. It provides multitasking and switching capabilities with today's DOS applications to make you more productive. But that's just the beginning. To find out more, read on.

COMPAQ®

ow to get to 20 MHz,
most out of 20 MHz.

erals operating at the industry-standard 8 MHz.

This flexible approach allows you to dramatically increase system throughput while preserving your investment in monitors, disk drives, and expansion boards. It can also accommodate today's and tomorrow's most advanced peripherals without constraining their performance.

Take options like our new Weitek™ Coprocessor Board. Never before offered in a PC, it can increase the speed of calculation-intensive, engineering and scientific applications by a factor of six, giving the COMPAQ DESKPRO 386/20 the performance of a dedicated engineering workstation at a fraction of the cost.

Compaq also provides 130- and 300-Megabyte Fixed Disk Drives with some of the industry's fastest access times. And when used with disk caching software, they represent the highest-performance storage subsystems available.

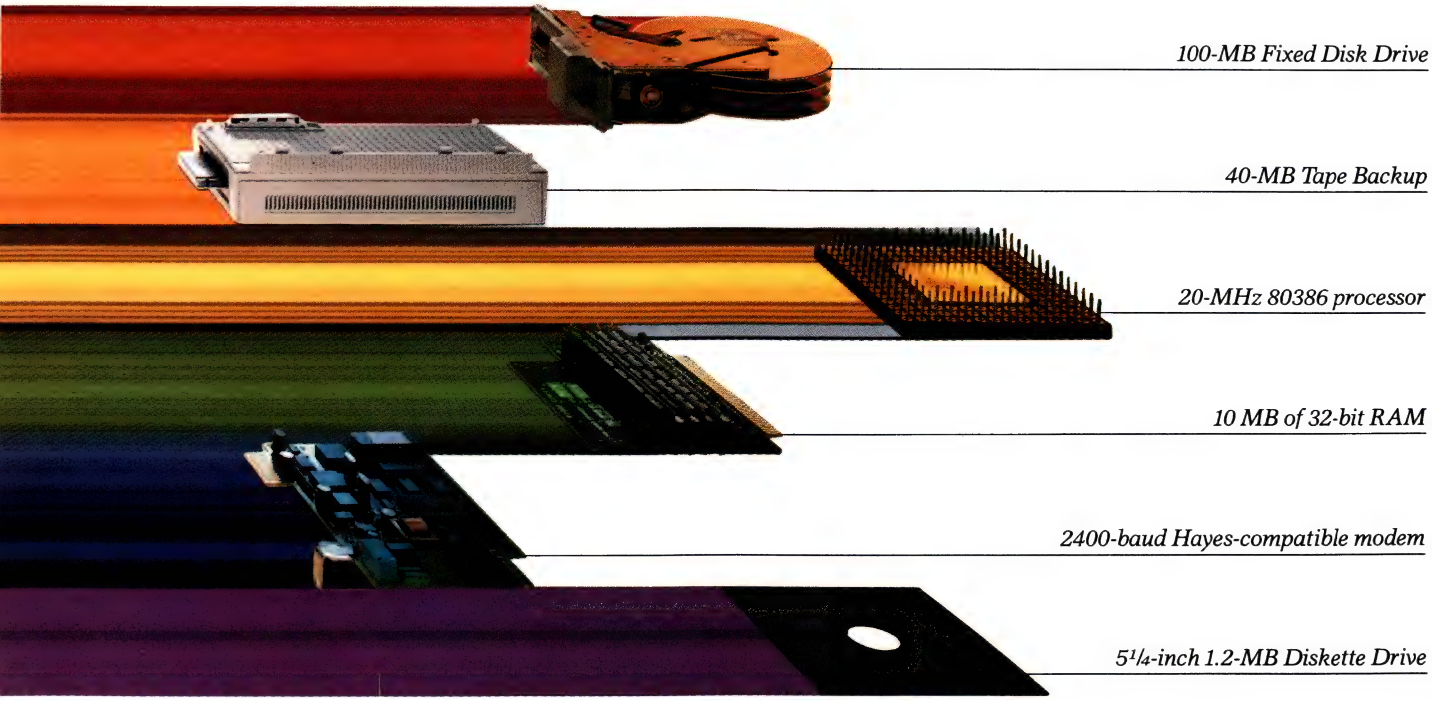
As for memory, Compaq offers 32-bit high-speed RAM. One full megabyte comes standard and is expandable to 16 megabytes without using an expansion slot. Plus, we included the COMPAQ Expanded Memory Manager. It supports the LIM standard so your software can break the 640-Kbyte barrier even before OS/2™ is released.

As tasks become more complex and users demand more advanced capabilities, Compaq responds by raising the standard of performance in personal computing.

COMPAQ

DESKPRO 386/20™

introduce a 386 portable PC.
xpected all this.



applications is increased even more when you add an optional 20-MHz 80387 coprocessor.

Memory? Get one megabyte of 32-bit, high-speed RAM standard or go as high as 10 MB internally. And like all of the COMPAQ 386-based PC's, it features the COMPAQ Expanded Memory Manager.

With our high-performance 100-megabyte internal fixed disk drive, you can actually fit 500 lbs. of data-filled pages into a 20-lb. PC, unsurpassed storage for a portable. If that's too much for you, we also offer a 40-megabyte model.

We've become famous for building desktop computer capabilities into our portables without leaving anything out. The COMPAQ PORTABLE 386 is more proof. It has a high-resolution, 640 × 400, 10-inch plasma display; a full-size, portable enhanced keyboard; two industry-standard expansion slots in a lightweight, optional plug-on unit; a choice between an optional 2400- or 1200-baud Hayes®-compatible modem; a full-size 5¼-inch 1.2-MB diskette drive; even an optional 40-MB tape backup.

These features, combined with the ultimate in portable performance, make the COMPAQ PORTABLE 386 the *biggest* PC this *small*.

COMPAQ

PORTABLE 386™

Nikkei-McGraw-Hill

A $124,000,000,000 market in Japan for U.S.-manufactured electronics. And the way to cash in.

Recent Ministry of International Trade and Industry guidelines and the rising value of the yen have created a $124 billion market for U.S.-manufactured electronic products, a market the likes of which U.S. electronics manufacturers have never seen.

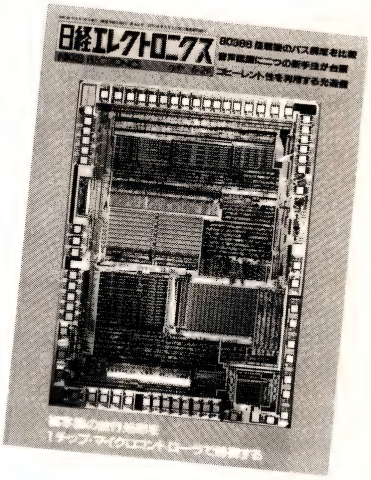
In fact, Japan's commitment to the development of supercomputers, 1-megabit DRAM (dynamic random access memory) chips, DAT (digital audio tape) recorders, and other advanced equipment, has the demand for electronic devices, computers, and measuring instruments at an all-time high.

And since the market embraces everything from consumer and industrial products to electronic components, now's the time for U.S. electronics manufacturers to cash in.

All that takes is an ad that reaches its target audience. That's where **NIKKEI ELECTRONICS** comes in. Because 67% of all **NIKKEI ELECTRONICS** subscribers are high-level electronics engineers involved in research, development, and design, experts who consider **NIKKEI ELECTRONICS** their business information source.

Indeed, for a piece of Japan's $124 billion electronics market, a piece in **NIKKEI ELECTRONICS** is all the U.S. electronics manufacturer requires. That and a good product is all it takes to cash in.

Exchange rate: US$1 = ¥145



Media Outline

- Japanese-language publication
- Published biweekly
- Available by subscription only
- Circulation: 53,062 (Japan ABC)

Affiliated Publications

Electronics, Data Communications and *Aviation Week & Space Technology*

NIKKEI ELECTRONICS

NIKKEI ELECTRONICS advertisements are handled by sales staff for ***Electronics*** *magazine.*

Western Sales Manager: Paul C. Mazzacano, McGraw-Hill/Electronics, 951 Mariner's Island Blvd., 3rd Floor, San Mateo, CA 94404, U.S.A. Tel: 415-349-4100

Costa Mesa Office: Fran Cowen, District Manager, McGraw-Hill/Electronics, 3001 Red Hill Blvd., Suite 222, Costa Mesa, CA 92626, U.S.A. Tel: 714-557-6292

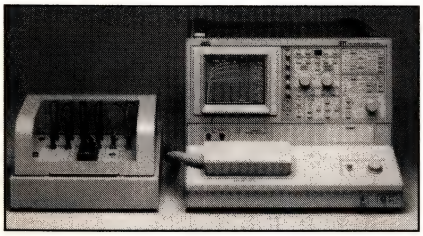
Los Angeles Office: Chuck Crowe, District Manager, McGraw-Hill/Electronics, 3333 Wilshire Blvd., Los Angeles, CA 90010, U.S.A. Tel: 213-480-5210

Englewood Office: Harry Doyle, District Manager, McGraw-Hill/Electronics, 7400 S. Alton Court, Suite 111, Englewood, CO 80112, U.S.A. Tel: 303-740-4633

San Mateo Office: Jeff Hoopes/District Manager or Rich Bastas/Regional Sales Manager, McGraw-Hill/Electronics, 951 Mariner's Island Blvd., 3rd Floor, San Mateo, CA 94404, U.S.A. Tel: 415-349-4100

Stamford Office: Al Liedel, District Manager, McGraw-Hill/Electronics, 777 Long Ridge Road, Bldg. A, Stamford, CT 06902, U.S.A. Tel: 203-968-7115

Tokyo Office: Tatsuo Ito, International Advertising Sales Manager, 1-14-6, Uchikanda, Chiyoda-ku, Tokyo 101, Japan Tel: (03) 233-8311 Telex: J29902 NKMCGRAW such as breakdown voltage and leakage current up to 3,000 V. It can handle on parameters such as forward-current transfer ratios and safe-pulsed operating area up to 400 A.



An internal bubble memory holds up to 16 front-panel setups that can be recalled by pressing a button. An industry-standard GPIB interface gives it connectivity to other test instruments.

Available now, the 371 costs $19,450.

Tektronix Inc., Marketing Communications Dept., P.O. Box 1700, Beaverton, Ore. 97075.
Phone (800) 547-1512 [Circle 385]

SCHEMATIC SOFTWARE DOES ANALOG, DIGITAL

Intelligent Applications USA has introduced Synergist, a diagnostic and schematic capture software program that can check out mixed analog and digital circuits from system level or board level down to individual components.

Synergist now runs on the Symbolics LISP machine, but the software will be adapted to the Apollo, Sun, and VAX work stations within the next year.

Available now, the software license for Synergist costs $10,000, and software support is priced at $1,500 a year.

Intelligent Applications USA, 9841 Broken Land Pkwy., Suite 206, Columbia, Md. 21046.
Phone (301) 381-6360 [Circle 387]

TOOLKIT HELPS DATA CAPTURE

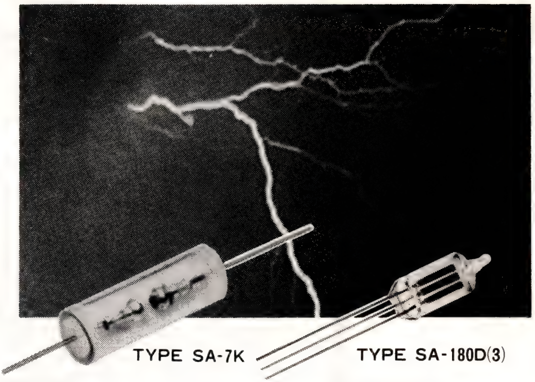
The Helios Toolbox software package from John Fluke Manufacturing Co. saves engineers the time of writing custom software for Fluke's Helios-I data-acquisition and control computer.

Written in Microsoft Corp.'s QuickBasic, the Helios Toolbox assists in gathering real-time data for parameters such as temperature, pressure, and flow rates. It runs on IBM Corp. Personal Computers AT, XT, and compatibles. Data can be scanned and logged using simple one-line statements, and analysis is speeded by automatically creating spreadsheets compatible with Lotus Development Corp.'s 1 2 3.

Available now, the Helios Toolbox software costs $295.

John Fluke Mfg. Co., P.O. Box C9090, Everett, Wash. 98206.
Phone (800) 426-0361 [Circle 388]

SURGE FREE
SURGE ABSORBABLE DISCHARGE TUBE
FOR CIRCUIT PROTECTION



● *TYPE*

Type	Breakdown Voltage (V) DC	Insulation Resistance (Ω)	Maximum Surge Current (8×20us) KA	Life Times at 500A
SA-80SS	80±10%	10^{10} min	1.0	1000
SA-200SS	200±10%	10^{10} min	1.0	1000
SA-80	80±10%	10^{10} min	1.5	1000
SA-140	140±10%	10^{10} min	1.5	1000
SA-200	200±10%	10^{10} min	1.5	1000
SA-250	250±10%	10^{10} min	1.5	1000
SA-300	300±10%	10^{10} min	1.5	1000
SA-7K	7000±1000V	10^{10} min	—	5000
SA-10K	10000±1000V	10^{10} min	—	5000
SA-180D(3)	180±10%	10^{10} min	2.5	1000

SA-180D(3) is a three electrode discharge tube.
All tubes can be made dark effect redused types which are available upon request. D is added to the model number, as in SA-80DSS.

● *POINT*

(1)Usable at wider ambient condition, especially good under high humidity.
(2)Visibility for operation.
(3)Compact and easy assembly.
(4)Stable characteristics.

● *APPLICATION*

Computer circuit.
Communication equipment.
Home Appliance.
Aircraft and Automobiles.

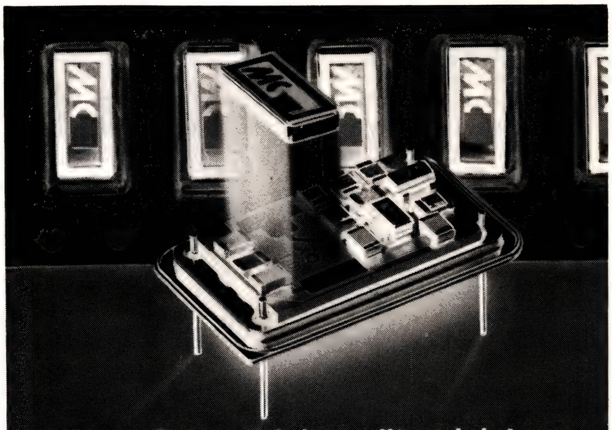
MAIN PRODUCT NEON GLOW LAMP, XENON FLASH LAMP, RARE GAS DISCHARGE LAMP
MINIATURE: BLACK-LIGHT, UV-LIGHT, FLUORESCENT COLOR-LIGHT.

ELEVAM corporation

NO. 17-8 CHUO 2-CHOME OTA-KU, TOKYO JAPAN TEL: 03(774)1231-5 TELEX: 246-8855 ELEVAM

Circle 153 on reader service card

QUARTZ CRYSTALS FOR SURFACE MOUNT



Micro Crystal high quality miniature quartz crystals for surface mounting are tailored to advanced microelectronics requirements.

- Mountable by vapor phase or infrared solder reflow, or wave soldering at 260° C for 20 sec.
- Available in 16 mm tape, double pitch, on standard 7" reel (up to 1k pieces per reel)
- Frequency range from 10 kHz to 4 MHz and 8 MHz to 24 MHz.

MICRO CRYSTAL/DIV. OF ETA

212/505-5340
ETA INDUSTRIES, INC.
35 East 21st St., New York, NY 10010

Circle 176 on reader service card

We promise to tell the truth the whole truth and nothing but the truth. So help us BPA.

As a member of BPA (Business Publications Audit of Circulation, Inc.) this magazine subscribes to the principle that it takes more than good faith to earn the business of advertisers. It takes good figures.

BPA, an independent, not-for-profit organization, audits our circulation data to make sure that advertisers get exactly what they pay for: you.

Once a year, BPA auditors examine our circulation list to make sure it's correct and up to date.

The audit makes sure you are who we say you are. It verifies your name, your company, your industry and your job title. This information enables our advertisers to determine if they're saying the right thing to the right people in the right place.

It also gives us a precise picture of who you are and, therefore, a good idea of what you want as a reader.

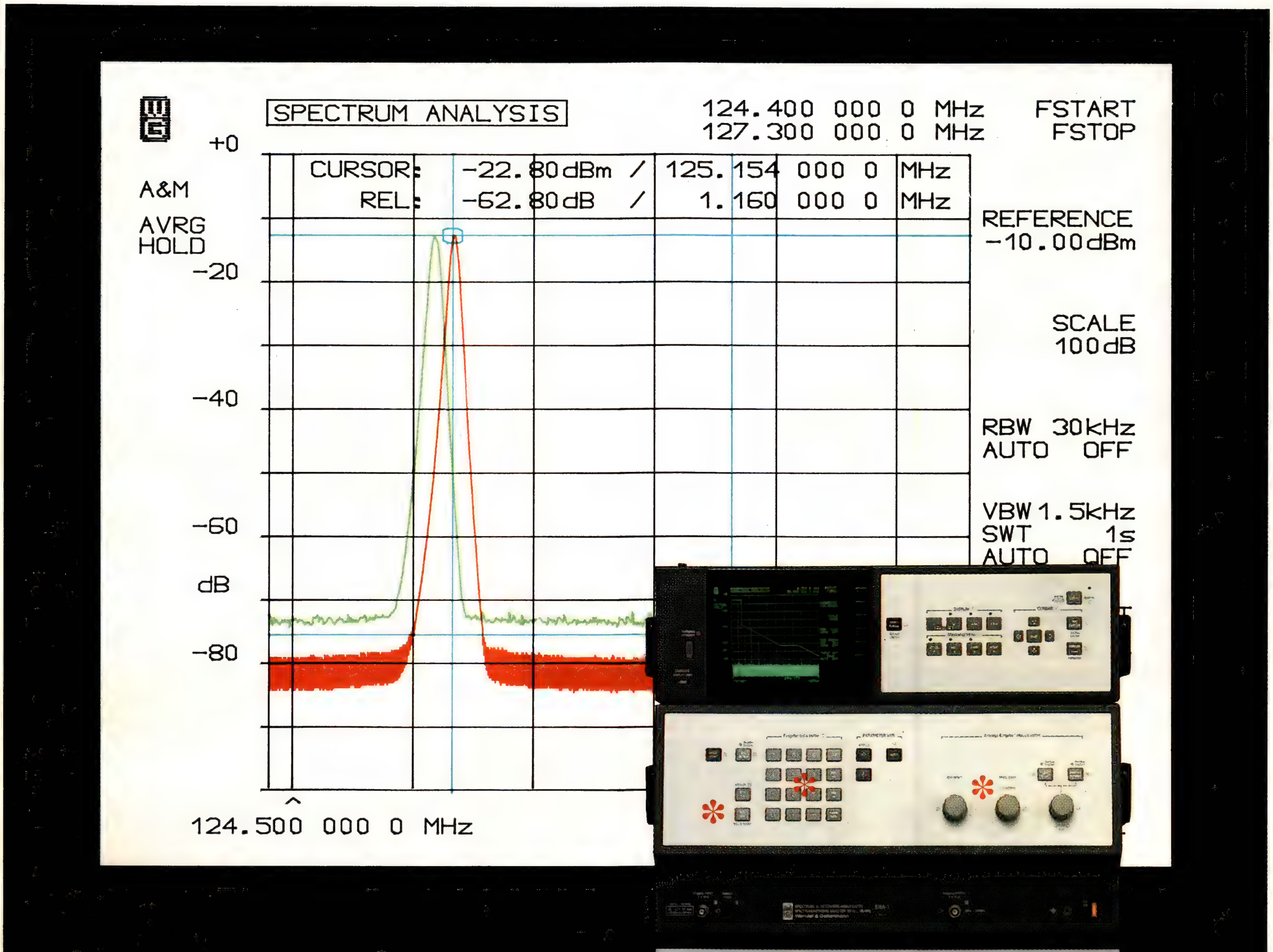
BPA. For readers it stands for meaningful information. For advertisers it stands for meaningful readers. Business Publications Audit of Circulation, Inc.
360 Park Ave. So., New York, NY 10010.

BPA

We make sure you get what you pay for.

Wandel & Goltermann

Electronic Measurement Technology



124.400 000 0 MHz FSTART
127.300 000 0 MHz FSTOP

CURSOR: -22.80dBm / 125.154 000 0 MHz
REL: -62.80dB / 1.160 000 0 MHz

REFERENCE
-10.00dBm

SCALE
100dB

RBW 30kHz
AUTO OFF

VBW 1.5kHz
SWT 1s
AUTO OFF

✻ Spectrum analysis difficult? Not with the SNA-1!

The SNA-1/01's favourable price and high measurement speed is a double guarantee for economical testing.
Simple ✻ digital- and ✻ analog-parameter entry ✻ Memory for 9 setups plus tolerance masks. Results are easy-to-read from the screen, digital noise averaging and IEC/IEEE interface.
Synthesiser accuracy for all frequency points on the x axis.
Auto cal facility gives the SNA-1 the accuracy that has established the reputation of our level meters.
Resolution 0.1 Hz, 0.01 dB. Display range 1 dB to 100 dB.

Wandel & Goltermann, VMW, Postfach 12 62, D-7412 Eningen
Fed. Rep. of Germany, Tel. +(49) 71 21-86-0, Tlx. 7 29 833

I would like the following:
☐ A free SNA-1 colour brochure
☐ A visit from a W&G sales engineer

Name ....

Company ....

Street ....

Town ....

Telephone no. .... E 7394 KF

EL 11/12/87

For USA contact:
W&G Inc.,RTP,NC 27709,Tel.919-9415-730

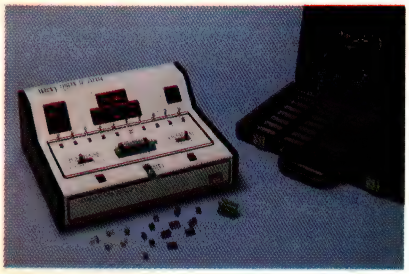
For Canada contact:
W&G Inc., Scarborough Ont. MIR 381,Tel.416-2917-121

Circle 157 on reader service card

New and Current
Products Presented
by the Manufacturer

Product Showcase

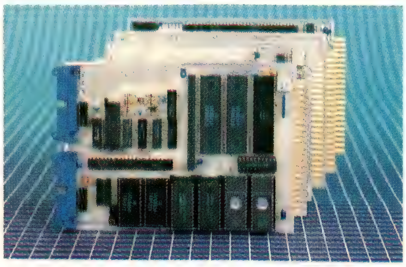
To advertise call Evelyn Schmidt, Advertising Manager (212) 512-6606



LOW COST LINEAR IC TESTER M-750

Provides DC/AC functional test and parametric measurement for most operational amplifiers and voltage comparators. "GO/NO GO" functional test, checks DUT's closed loop stability, level swings and gain bandwidth. 4½-digit auto ranging, auto unit display offers fast and easy measurement up to ten different parameters. RS-232C & IC handler interface. Price: $2,495
Information Scan Technology, Inc.
487 Gianni St., Santa Clara, CA 95054
(408) 988-1908

INFORMATION SCAN TECHNOLOGY, INC. CIRCLE 242



6809 SINGLE-BOARD COMPUTER

6809 MPU, 2 serial ports, 4 parallel ports, RAM, EPROM, real-time clock, watchdog timer, 44-pin 4.5″ x 6.5″ PCB

EXPANSION MODULES: RAM, EPROM, CMOS RAM/battery, analog I/O, serial I/O, parallel I/O, counter/timer, IEEE-488, EPROM programmer, floppy disks, cassette, breadboard, keyboard/display.

Wintek Corporation
1801 South Street
Lafayette, IN 47904-2993
(317) 742-8428 or
(800) 742-6809

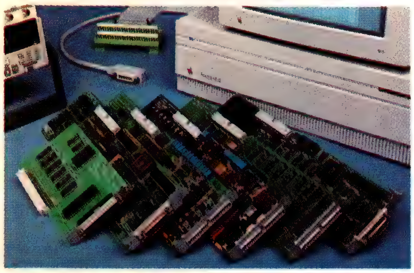
WINTEK CORP. CIRCLE 236

EXORbus™ COMPATIBLES? OF COURSE!

EXORbus compatible, 6800/6809 family of micro modules for use in process control, production automation, materials testing and data acquisition systems. The 9636 64K Non-Volatile Memory Module is $185.25 each at 100 pieces. Uses 8K X 8 EPROMS or RAMS. Take a look at our 1987 Catalog, "Everything for the EXORbus". Contact Creative Micro Systems, 3822 Cerritos Ave., Los Alamitos, CA 90720. (213) 493-2484

CREATIVE MICRO SYSTEMS CIRCLE 226

MACINTOSH PRODUCTS FOR SCIENTISTS AND ENGINEERS

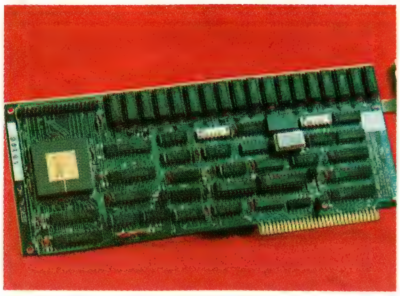


LabVIEW — Graphical Software Construction System for instrument control and data acquisition
Data Acquisition for Macintosh II — A/D, D/A, DI/O, DMA, Timing/Triggering
IEEE-488 Interfaces — For entire Macintosh series

NATIONAL INSTRUMENTS™
12109 Technology Blvd.
Austin, Texas 78727-6204

Call for FREE Catalog
800-531-4742
512-250-9119

CIRCLE 250



PC-RISC SYSTEM: 40 MIPS

Fill your PC/XT/AT with 1 to 6 PC4000 boards for a high speed PC-RISC System and get up to **40 MIPS in your PC** • Parallel operation • ½ MByte per board • Each PC4000 is more than 2 x speed of VAX 11/780 or 68020 • NC4016 RISC Engine CPU • C(K&R), Assembler & Forth available • Comes w/ dev software • 2 weeks delivery ARO • From $1,295 • Silicon Composers, 210 California Avenue, Suite I, Palo Alto, CA 94306 • 415-322-8763

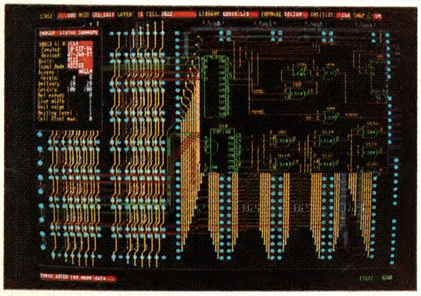
SILICON COMPOSERS CIRCLE 202

HERE IS AMAZING PROGRAMMING POWER

- Three Levels of Programming Power
  - 28U UNIVERSAL; 28L LOGIC; 28E EE/EPROM
- Over 900 devices from 24 device manufacturers
  - PLD's, EPLDS, EEPLDS, EPROMS, EEPROMS, MICROS, BIPOLAR PROMS.
- No sacrifice in performance
  - Vector testing with register pre-load, check summing, with a footprint smaller than this page.

Inlab Inc. 1-800-237-6759, (303) 460-0103
2150-I West 6th Avenue, Broomfield, CO 80020

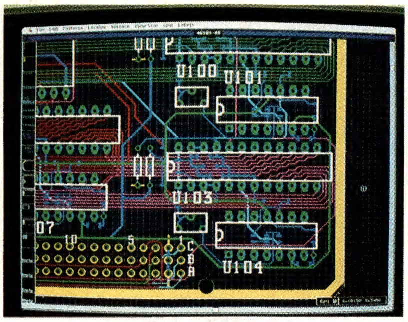
INLAB INC. CIRCLE 273



SCHEMATIC CAPTURE TO PCB LAYOUT $695.00

Before buying EE Designer, FutureNet, PCAD, or separate Schematic & PCB editors, check our one CAD Total Solution. Schematic/PCB editor supports 15 hierarchy levels, 50 layer, auto parts package, rat's net, rubber banding, 1 mil resolution, unltd trace widths, GND plane, etc. Optional Auto-Router and GERBER. $75.00 for 30 day evaluation. Interactive CAD Systems, 2352 Rambo Court, Santa Clara, CA 95054. (408) 970-0852.

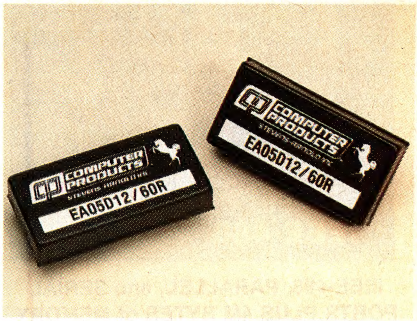
INTERACTIVE CAD SYSTEMS **CIRCLE 244**



NEW FULLY INTEGRATED CAD/CAM

Douglas CAD/CAM Professional System was created for the serious circuit board designer with full integration of layout, schematic capture and autorouting. The software runs on the Apple Macintosh, supports color and unlimited multilayers. Output is to printers, pen plotters and photoplotters. Layout $1500, Schematic $700, Autorouter $700. Douglas Electronics, 718 Marina, San Leandro, CA 94577 (415) 483-8770

DOUGLAS ELECTRONICS **CIRCLE 202**



COMPUTER PRODUCTS "EA" SERIES 1.8 WATT DC/DC CONVERTER

• Industry Standard 1 x 2 x .38″ Package • 5V Input • ± 12 @ 60 mA or ± 15 @ 60 mA Output • Regulated • Isolated • Short Circuit Protection • Ideal for RS232 Interface • Cost Effective On-Board Point of Use Regulation • Available from Stock • For More Information, 617/268-1170. Computers Product, Stevens-Arnold Division, 7 Elkins Street, Boston, MA 02127.

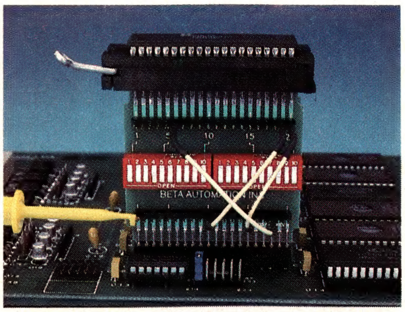
COMPUTER PRODUCTS **CIRCLE 234**

PC/MS DOS, VAX VMS, UNIX

* Fast Version 2.2
* Conditional assembly
* Binary or ASCII Hex file output
* New expanded Manual
* Powerful macros
* Relocatable or absolute code

ENERTEC INC, 19 Jenkins Ave.
Lansdale, PA 19446 215-362-0966
telex 4948709 MC/V

CIRCLE 208



BUGS IN YOUR CIRCUIT?

Wasting time wrapping, unwrapping, cutting traces, bending leads? Test your ideas quickly and easily with the DIP ISOLATOR. Isolate any pin of a DIP IC. Use test points for rewiring. Use with emulator probe to turn off unwanted interrupts, resets. Sizes from 6 to 64 pins. Prices from $22.75. Beta Automation Inc. 3541 Old Conejo Rd., Newbury Park, CA 91320. 805/499-5785.

BETA AUTOMATION **CIRCLE 253**

COMPUTER PRODUCT "ES" SERIES 15 WATT TRIPLE OUTPUT DC/DC CONVERTER

• Wide Input 9 to 18, 18 to 36 or 36 to 72 VDC • Three Output Combinations 5/ ± 12, 5/ ± 15 and 5/ ± 12/ – 5 • Efficiency to 82% • Ideal for Battery Applications Requiring Low Noise Analog and Digital Output • Available From Stock • For More Information, 617/268-1170, Computer Products, Stevens-Arnold Division, 7 Elkins Street, Boston, MA 02127.

COMPUTER PRODUCTS **CIRCLE 232**

Product Showcase Order Form

The best value for your advertising dollars. For a 1/9 page ad, here's all you have to do:

1) Send a 35mm color transparency of your product. (Black and white glossy photos are also accepted.)
2) Include 10 lines of typed copy, no more than 43 characters to a line. (Include spaces between words and punctuation in your character count.)
3) Write a headline of 32 characters or less.
4) We do all the rest. No production charges.
5) We also accept camera-ready art. Ad size: 2¼″ wide x 3⅛″ deep.

1x	$750	7x	$715	18x	$600
3x	$735	12x	$645	25x	$570

Send this form with material to: Carol Helton, *Electronics* magazine, Product Showcase Advertising Manager, 1221 Avenue of the Americas, 42nd Floor, New York, NY 10020. (212) 512-2143

Name

Title

Company

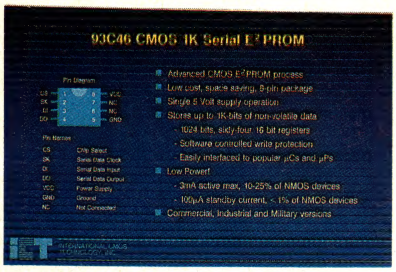
Address

city

State Zip

Phone

Electronics


93C46 CMOS 1K Serial E² PROM

Pin Diagram

CS 1 8 VCC
SK 2 7 NC
DI 3 6 NC
DO 4 5 GND

Pin Names

CS	Chip Select
SK	Serial Data Clock
DI	Serial Data Input
DO	Serial Data Output
VCC	Power Supply
GND	Ground
NC	Not Connected

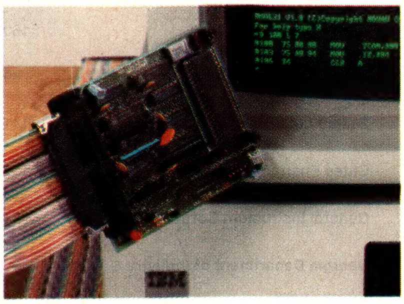
- Advanced CMOS E²PROM process
- Low cost, space saving, 8-pin package
- Single 5 Volt supply operation
- Stores up to 1K-bits of non-volatile data
  - 1024 bits, sixty-four 16 bit registers
  - Software controlled write protection
  - Easily interfaced to popular μCs and μPs
- Low Power!
  - 3mA active max, 10-25% of NMOS devices
  - 100μA standby current, < 1% of NMOS devices
- Commercial, Industrial and Military versions

INTERNATIONAL CMOS TECHNOLOGY, INC.

1024-BIT SERIAL CMOS EEPROM

The 93C46 is a CMOS EEPROM configured as a 1K bit serial access, 64x16, 5 volt only. The device draws only 3 milliamps max. active and 100 microamps in standby. For applications requiring up to 10,000 erase/wire cycles per register. The 93C46 is in stock at all Marshall Industries locations. Pricing is $1.66 each for 100 pieces. International CMOS Technology, Inc., 2125 Lundy Av., San Jose, CA 408/434-0678.

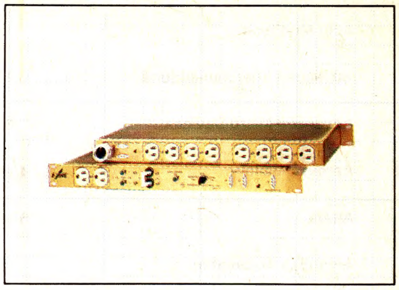
INTERNATIONAL CMOS TECH. **CIRCLE 217**



EMULATORS 8051/52, 8031, 80C31, 8032, 8344, 80C452, 80C152, 80535, 80C451

• IBM PC plug in boards • 64K emulation memory • 16MHz full speed Real Time Emulation • Command driven User Interface with static windows • Advanced trace capabilities • 16K trace buffer • Powerful Macros • Supports PL.M-51, C51 • Symbolic debugging • Prices: 32K 8031 $1790, 4K Trace $1495. **FREE DEMO DISK! CALL NOHAU CORP.,** 51 E. Campbell Ave., Campbell, CA 95008. 408/866-1820.

NOHAU **CIRCLE 211**



Z-LINE® POWER DISTRIBUTION & CONTROL SYSTEMS

A/C POWER DISTRIBUTION AND CONTROL SYSTEM MODEL TPC 115-10A MTD™, SPACE SAVER DESIGN FOR CLEAN POWER UP WITH MULTIPLE TIME DELAY™ PREVENTS HIGH CURRENT INRUSH BY SEQUENCING YOUR COMPUTERS POWER UP. FILTERS A/C LINE VOLTAGE AND PROTECTS YOUR SYSTEM FROM VOLTAGE SPIKES AND SURGES. PRICED FROM $422 TO $296. TO ORDER CALL (714) 540-4229 FAX (714) 641-9062 OR WRITE PULIZZI ENGINEERING, INC., 3260 S. SUSAN ST., SANTA ANA, CA 92704-6865

PULIZZI ENGINEERING, INC. **CIRCLE 222**

IBM COMPATIBLE RS232 EASI-DISK 3½"/5¼" FLOPPY DATA STORAGE & TRANSFER SYSTEMS

Information Transfer to/from Non IBM Compatible Systems to/from IBM and Compatibles: (Over RS232 Interface or 488 Interface).

- Reads & Writes IBM PC/MS DOS Disks
- RS-232CI/O/488
- Rugged Portable Package/Battery Option
- ASCII or Full Binary Operation
- Baud Rates 110 to 38.4 K Baud
- Automatic Data Verification
- Price $895 in Singles - OEM Qtys. Less.

28 other systems with storage from 100K to 35 megabytes.

ADPI
Analog & Digital Peripherals, Inc.
815 Diana Drive Troy, Ohio 45373
513/339-2241 TWX 810/450-2685

FLOPPY DATA STORAGE **CIRCLE 214**

IEEE488

Technology that hits the mark

- For **IBM-PC/XT/AT/IC/RT6150** and all other compatible computers
- For PHILIPS PC **:YES**
- **HP commands** (enter, clear etc.) implemented
- **SRQ/ASYST** compatible
- **64 kByte** memory capacity
- **DMA** and **INTERRUPT** can be activated by **simple commands**
- **HELP functions, SYNTAX** monitoring in **clear text**
- BASIC, BASIC(compiled), TURBO-BASIC, (TURBO-) PASCAL, MODULA-2, FORTRAN, C, ASSEMBLER

DEALER + OEM WELCOME

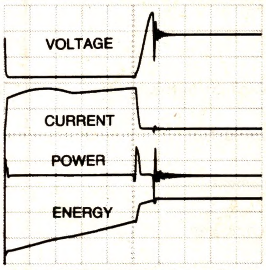
CIRCLE 235

ines
Messtechnik
Datenverarbeitung

Ines GmbH
Neuenhöfer Allee 45
5000 Köln 41
West-Germany
Phone: -49-2 21-43 86 59
Teletex: -26 27-2 21-42 37 gizkln
FAX: -49-2 21-49 18 71

Analog Circuit Simulation

A full featured SPICE based simulator runs on the IBM PC with interactive Input and Output



These waveforms show an IS_SPICE analysis of a power supply snubber. Intu_Scope was used for display and computation of power and energy. The output shown used an Intu_Scope plotter utility

PRE_SPICE, $200.00: Interactive control, Monte Carlo Analysis, Optimization, libraries and parameter evaluation.
IS_SPICE, $95.00: Performs AC, DC and Transient analysis.
Intu_Scope, $250.00: Displays, manipulates and plots data.
Programs are not copy protected, come with a 30 day money back guarantee and require PC with 640K RAM, fixed disk, coprocessor and CGA or EGA or Hercules graphics.

intusoft

P.O. BOX 6607
San Pedro, CA 90734-6607
Tele: (213) 833-0710

INTUSOFT **CIRCLE 229**

NEW STATIONARY INPUT — MOUSE-TRAK

• The space saving input device that emulates both Microsoft and Mouse Systems RS-232 mice. • With a single connection to your computer, no power supply is needed. • MOUSE-TRAKs ergonomic design puts complete control of cursor and input at your fingertips. • Speed control allows the user to toggle the resolution with a 4:1 ratio. • User defineable keys adds versatility and comfort. For Further Information, Contact: 1303 Columbia, Suite 217, Richardson, Texas 75081 (214) 234-5366

ITAC SYSTEMS, INC. **CIRCLE 237**

THE IPC-SBC88 DEVELOPMENT AND CONTROL SYSTEM

WRITE IT — RUN IT — ROM IT

A single board computer development and control system that is so simple to use, you will be developing applications programs the first day!

• Choice of Basic or FORTH in ROM	• Onboard EPROM programmer for complete program development
• 8 channel, 8 bit analog to digital converter	• RS-232 terminal and parallel printer port for program entry
• Two 8 bit input ports Two 8 bit output ports	• 7 current sinking outputs rated at 500 mA, 50 VDC
• Time of day	• Up to 32 K of user memory
• 8088 16 bit uP	• Low Cost $59 at 1000

MasterCard and Visa accepted

Vesta Technology, Inc. 7100 W. 44th Ave. Suite 101
Wheat Ridge, CO 80033 (303) 422-8088

CIRCLE 246

---

edi electronic devices, inc.

your prime source for
bridge rectifiers, silicon rectifiers
standard, fast, and
superfast recovery times

Mini-Catalog

Bridge Rectifiers
Axial Lead Rectifiers
High Voltage Packs
Cartridge Rectifiers
Special Devices
O.E.M. Television and CRT Rectifiers
Solid-Tube Rectifiers

BRIDGE RECTIFIERS AND HV DIODES AND ASSEMBLIES

Thousands of stock items are shown in the mini-catalog. HV diodes, silicon bridges packs, assemblies, cartridges, solid-state rectifier tubes are illustrated. They feature power to 100 amps, all voltages, with standard fast and superfast recoveries (to 50 NS). Many case styles, terminations, and custom designs available. Electronic Devices, Inc., 21 Gray Oaks Ave., Yonkers, NY 10710. (914) 965-4400.

ELECTRONIC DEVICES **FREE COPY CIRCLE 203**

Advertising Sales Staff

Atlanta, Ga. 30319: Joseph Milroy
4170 Ashford-Dunwoody Road N.E.
[404] 252-0626
Boston, Mass. 02116:
M. E. "Casey" McKibben, Jr.
575 Boylston St.
[617] 262-1160
633-0155 Mobil Phone
Chicago, Ill. 60611: Alison Smith
[312] 751-3738
645 North Michigan Avenue
Cleveland, Ohio 44113:
[215] 496-3800
Costa Mesa, Calif. 92626: Fran Cowen
3001 Red Hill Ave. Bldg. #1 Suite 222
[714] 557-6292

Dallas, Texas 75251: Harry B. Doyle, Jr.
8111 LBJ Freeway, Suite 350
[214] 644-1111
Englewood, Co. 80112: Harry B. Doyle, Jr.
7400 South Alton Court Suite 111
[303] 740-4633
Houston, Texas 77040: Harry B. Doyle, Jr.
7600 West Tidwell, Suite 500
[713] 462-0757
Los Angeles, Calif. 90010: Chuck Crowe
3333 Wilshire Blvd.
[213] 480-5210
New York, N.Y. 10020
Matthew T. Reseska [212] 512-3617
John Gallie [212] 512-4420
Stan Tessler [212] 512-2788
1221 Avenue of the Americas
Stamford, Ct. 06902
Albert J. Liedel
777 Long Ridge Road. Bldg. A
[203] 968-7115
San Mateo, Ca 94404:
Rich Bastas, Jeffrey C. Hoopes, Paul Mazzacano
3rd Floor
951 Mariner's Island Blvd.
[415] 349-4100
Philadelphia, Pa. 19102: Joseph Milroy
Three Parkway, [215] 496-3800
Pittsburgh, Pa. 15222: Joseph Milroy
Suite 215, 6 Gateway Center, [215] 496-3800
Southfield, Michigan 48075:
4000 Town Center, Suite 770, Tower 2
[313] 352-9760
San Francisco, Calif. 94111:
Rich Bastas, Jeffrey C. Hoopes, Paul Mazzacano
425 Battery Street
[415] 362-4600

Frankfurt/Main: Fritz Krusebecker, Dieter Rothenbach
19 Liebigstrasse, Germany
Tel: 72-01-81
Milan: Manuela Capuano
1 via Baracchini, Italy
Tel: 86-90-656
Paris: Jean - Christian Acis, Alain Faure
128 Faubourg Saint Honore, 75008 Paris, France
Tel: [1] 42-89-0381
Scandinavia: Andrew Karnig
Finnbodavagen
S-131 31 Nacka
Sweden
Tel. 46-8-440005
Telex: 17951 AKA S
Tokyo: Hirokazu Morita
McGraw-Hill Publications Overseas Corporation,
Kasumigaseki Building 3-2-5, chome,
Kasumigaseki, Chiyoda-Ku, Tokyo, 100 Japan
[581] 9811

United Kingdom: Art Scheffer
34 Dover Street, London W1
Tel: 01-493-1451

Business Department

David M. Yake
Business Manager
[212] 512-2627
Daniel McLaughlin
Director of Circulation
[212] 512-6598
Roseann Lehmann
Office Administrator
[212] 512-3469
Frances M. Vallone
Manager, Reader/Sales Services
[212] 512-6058
Ann Strignano
Billing Specialist
[212] 512-2589
Thomas M. Egan
Production Director
[212] 512-3140
Carol Gallagher
Production Manager
[212] 512-2045
Evelyn Dillon
Production Manager Related Products
[212] 512-2044
Postcards/Product Showcase
[212] 512-2143

Classified Advertising

[212] 512-2556

Recruitment Advertising

[212] 512-2787
Subscription Sales
[201] 988-3258

POSITIONS WANTED

Electronic Engr, for hire. Microprocessor based designs, controls, telecom. Contract or per diem. Mr. Barry Masel. 718-476-1516.

SPECIAL SERVICES

Overseas — 75 Countries — Interviewing now. All Fields — for Conn. interview. Send resume: Global Services, (O) Clinton, CT 06413. Transportation not paid to Connecticut.

Confidential Design, prototype, short production run services. CAD PCB layout. Micro-P Control Systems, Interactive Video, Smart House, Telecom. Communications Systems Labs, 23 S. Kam Hwy, #206, Wahiawa, HI 96786 Telex 6502990026MCI or Toll-Free 800-521-1364.

Hardware and software development and in-house consulting in the following areas: Microprocessor based products, interactive video, machine controllers, video, video overlay, PC and PC/AT based systems. Applied Computer Techniques, Inc. 3914 Dekalb Dr., Orlando, Florida 32809. (305) 851-2525, Incorporated 1978.

Professional Services in Design, Prototypes, Low Volume Production and SMT designs. Flexible Fees. Dan-Mar Electronics. 301-252-5414.

INVENTIONS WANTED

Inventions, ideas, new products wanted! Industry presentation / national exposition. Call 1-800-288-IDEA. Canada, 1-800-528-6060. X831.

TO ANSWER BOX NUMBER ADS: Address separate envelopes (smaller than 11″ x 5″) for each reply to:

Box Number (As indicated)
Classified Advertising Department
Electronics
Post Office Box 900, NY 10108

COMPUTER MARKET PLACE

100Mhz Logic Analyzer Card
For PC/XT, PC/AT Monochrome & Color Card Systems
$1199

- 24 Channels at 25Khz - 25 Mhz
- 6 Channels at 100 Mhz
- Internal Clock up to 100Mhz
- External Clock up to 25Mhz
- Threshold Voltage TTL, ECL, or variable from -10 to +10v
- Totally Software Controlled
- All Software Included

PAL/EPROM Programmer Card
For PC/XT/AT Systems

$399

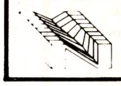
- Programs All 20 and 24 Pin MMI, NS, TI PALs
- Programs Eproms from 2716 to 27512 and 27512A
- Software Functions Include: Read, Write, Verify, Protect, Edit, Print, and File Save and Load of Program.
- All Software Included

CALL NOW FOR ORDERS
AND TECHNICAL INFORMATION (201) 994-6669
Link Computer Graphics, Inc. 4 Sparrow Dr.,
Livingston, NJ 07039

SPICE up your *PC*

Z/SPICE professional circuit simulation
Full version $300 Student version $79
ZTEC 6745 Lindley Ave., Reseda, CA 91335
(818) 609-8948

SPICE Circuit Simulation
8/16/32 bit PC's
PC too slow? Need > Maxmem?



Northern Valley Software
28327 Rothrock Dr. R.P.V.,CA.
(213) 541-3677 90274

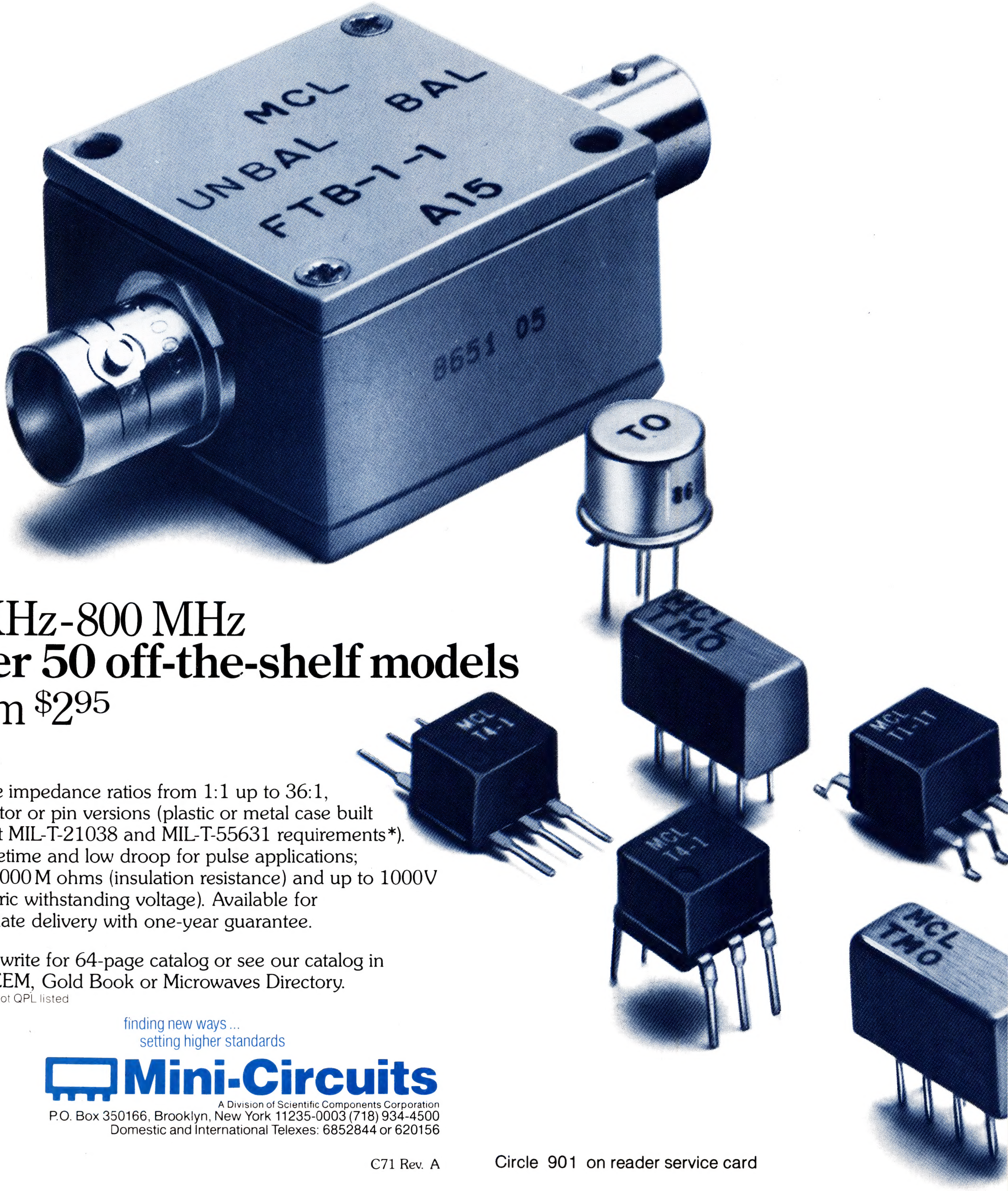
RELIABILITY PREDICTION SOFTWARE
ARE YOUR PRODUCTS RELIABLE?
RelCalc 2 automates MIL-HDBK-217D on your IBM PC!
Very easy to use. Demo package $25.
T-CUBED SYSTEMS
(818) 991-0057
31220 La Baya Drive, #110
Westlake Village, CA 91362

HOT LINE

To place your Computer Software Ad

Call Ilene Fader
212-512-2984

RF transformers



3 KHz-800 MHz
over 50 off-the-shelf models
from $2^{95}

Choose impedance ratios from 1:1 up to 36:1, connector or pin versions (plastic or metal case built to meet MIL-T-21038 and MIL-T-55631 requirements*). Fast risetime and low droop for pulse applications; up to 1000M ohms (insulation resistance) and up to 1000V (dielectric withstanding voltage). Available for immediate delivery with one-year guarantee.

Call or write for 64-page catalog or see our catalog in EBG, EEM, Gold Book or Microwaves Directory.
*units are not QPL listed

finding new ways...
setting higher standards

Mini-Circuits
A Division of Scientific Components Corporation
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500
Domestic and International Telexes: 6852844 or 620156

C71 Rev. A

Circle 901 on reader service card